# VILLAGE OF RUIDOSO
# AND
# CITY OF RUIDOSO DOWNS
# JOINT USE BOARD

## WASTEWATER TREATMENT PLANT
## PRELIMINARY ENGINEERING REPORT

May 2006

# FINAL DRAFT

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## EXECUTIVE SUMMARY

The Village of Ruidoso and the City of Ruidoso Downs (collectively referred to as Ruidoso) jointly own and operate the Ruidoso Wastewater Treatment Plant pursuant to a National Pollutant Discharge Elimination System (NPDES) permit (No. NM0029165) issued by the U.S. Environmental Protection Agency (EPA), Region 6.

The existing Plant, which discharges to the Rio Ruidoso, is not designed to comply with the effluent nutrient limits set forth by the current permit. The plant sludge treatment system is nearly overwhelmed, and the plant cannot handle any significant increase in loading and still maintain reasonable standards of effluent organic and solids content. It is urgently necessary to expand the plant capacity and to design the expanded plant for biological nutrient removal (BNR), which refers to the biological removal of nitrogen and/or phosphorus. This will require a major construction project, which is the focus of this draft preliminary engineering report (PER).

The permit limits the plant discharge to 0.1 mg/l phosphorus, and compliance with this limit will require heavy chemical treatment of the plant throughput. During the preparation of this PER, Ruidoso investigated the possibility of an increase in the effluent phosphorus limit to 1.0 mg/l utilizing a "Water Quality Trading Program" to reduce or eliminate non-point source discharges of phosphorus to the Rio Ruidoso in exchange for the increased effluent limit. A consultant was retained to investigate the potential of the proposed Water Quality Trading Program, and it was concluded that such a program lacked the necessary trading potential on this segment of the Rio Ruidoso. As such, the 0.1 mg/l effluent phosphorus limit is in effect and compliance with this limit will be required. Consequently, despite occasional references to a 1.0 mg/l effluent phosphorus limit, this PER should be understood as reflecting Ruidoso's commitment to construct and operate a plant capable of meeting the required 0.1 mg/l effluent phosphorus limit.

Since the 1.0 mg/l phosphorus effluent limit was being studied during the preparation of this PER, the PER has been prepared to address both a 1.0 mg/l and 0.1 mg/l phosphorus limit. This PER presents a plan for installation of a biological treatment process capable of reducing plant effluent phosphorus to 1.0 mg/l. The PER further presents a tertiary chemical process that is installed downstream of the activated sludge process to achieve the required phosphorus limit of 0.1 mg/l.

The permit limits the total plant effluent toxicity, which is affected by effluent concentration of ammonia. Moreover, future permits may limit effluent ammonia, nitrate, or both. Hence, the permit requires biological ammonia removal, or *nitrification*. This PER also recommends biological nitrate removal, or *denitrification*. The latter is recommended for compliance with future permits, additional biological phosphorus removal, reduced power consumption, improved process operation, and improved process flexibility.

With regard to the current permit, this PER rates the existing plant capacity at 0.54 million gallons per day (mgd). At present, average daily influent is roughly 1.4 mgd. Using multiple methods of future flow projection, this PER predicts that plant loading may increase to 2.5 mgd by the year 2015, and to 3.75 mgd by the year 2030, which is the end of the 25-year planning period used for this PER. Hence, a major plant expansion is necessary, and it is recommended that the plant be expanded in two phases. Phase I should expand the plant capacity to 2.5 mgd and allow for BNR. Phase II should expand the plant to 3.75 mgd. This PER focuses primarily on the Phase I expansion.

Most of the existing plant components are not suitable for reuse in the Phase I expansion, either because they are too old, too small, of questionable structural integrity, or inappropriate for modern methods of wastewater treatment. Also, the existing plant site is too small for the use of shallow treatment basins, which occupy more surface area. Deeper basins are necessary to provide adequate treatment volume on the plant site.

The limited amount of space on the existing plant site will make construction of the Phase I expansion difficult, because the existing process must continue operating while the new site is built. The preferred solution to this problem is to acquire roughly two acres of land to the west of the existing site. If additional land cannot be acquired, it will be necessary to *stage* the construction, or to build the plant in a manner that allows stepwise demolition of existing modules so that new modules can be built in their place. Because staging is more expensive and problematic than the use of new land, Ruidoso is committed to acquiring the additional needed land.

This PER screens seven alternatives for expanding the plant, including alternatives such as effluent reuse, discharge to groundwater, and batch reactors. The alternatives are screened based on criteria such as cost and operability. All but three alternatives are eliminated, and these are summarized as follows:

- Alternative 1 is based on a conventional BNR process with a pre-anoxic denitrification.
- Alternative 2 is based on simultaneous nitrification and denitrification (SNdN).
- Alternative 3 is based on the use of membrane bioreactors (MBRs) for enhancement of phosphorus removal, replacement of the secondary clarifiers, and production of a cleaner effluent.

As of this writing, Alternative 3 is far more expensive than Alternatives 1 and 2, and for this reason, Alternative 3 is tentatively eliminated. However, Alternative 3 has significant advantages over Alternatives 1 and 2 with respect to effluent quality, permit compliance, and the efficient use of plant space. Moreover, the cost of MBRs may fall over time due to increased competition between manufacturers of the technology. Alternative 3 should be evaluated again before the start of preliminary design, as it may become competitive with Alternatives 1 and 2.

Alternatives 1 and 2 differ only in the operation of the proposed treatment basins. Essentially, this PER proposes one process with two variations. The process is described as follows. All modules are new unless otherwise noted.

Wastewater influent enters submersible pump station, which discharges to the bar screens. The new bar screens have smaller openings than the existing screens. This keeps large objects from entering the plant and damaging the proposed sludge belts. Screened flow passes through a new grit-removal chamber. A chemical feed station allows for the addition of caustic soda or solution downstream of the grit chamber, as may be necessary to raise the influent alkalinity. Flow enters the anaerobic selector, where phosphorus is removed biologically.

Flow enters two parallel treatment basins, where reduction of organics, nitrification, and denitrification are carried out using one of two methods. Alternative 1 proposes a conventional BNR process, in which each basin has a pre-anoxic zone, an aerobic zone, and a recycle stream from the aerobic zone to the anoxic. Alternative 2 proposes a BNR process in which the rate of biological activity is tightly controlled, allowing for simultaneous nitrification and denitrification. The choice between Alternatives 1 and 2 should be made during preliminary design, based on consultation between the plant staff, the Joint Use Board, and the engineer. The estimated costs for each are similar.

Flow passes through two secondary clarifiers and through a chemical treatment system, which is required to enable the plant to meet the 0.1 mg/l effluent phosphorus limit. Water passes through an ultraviolet (UV) disinfection system, a new effluent flowmeter, and to the existing outfall.

Waste sludge is pumped to a belt thickener, and then to an aerobic digester. Digested sludge is pumped to a belt press, which concentrates the sludge to roughly 19 percent solids. The sludge can be composted on the existing drying beds or removed from the site.

A new Laboratory and Administration Building is proposed. This building has a control room, where operator(s) can use a distributed control system to monitor and control all plant modules.

The total estimated capital cost of the project required to meet the 0.1 mg/l phosphorus limit is $29.2 million. Operating costs are estimated to be $954,000 annually.

# 1.0 GENERAL

## 1.1 Project Background

The resort area of Ruidoso encompasses the Village of Ruidoso and the City of Ruidoso Downs, which are proximate communities located in south-central New Mexico.

Ruidoso sits high in the Sacramento Mountains and is surrounded by the Lincoln National Forest. The elevation reaches 7,000 feet in Ruidoso itself and 10,000 feet in the surrounding mountains. This pristine, forested environment offers numerous outdoor activities such as fishing, hiking, camping, and skiing. Ruidoso's tourism results in a large number of part-time residents, and tourists may double the population of Ruidoso during peak tourist seasons.

Ruidoso is the principle community of Lincoln County, which ranked second in population growth among all New Mexico counties between 1990 and 2000, according to Census 2000 data. During the 1990s, the population of Lincoln County grew by 59 percent, and the permanent population of Ruidoso itself grew by 71 percent, making it one of the fastest-growing communities in New Mexico. Although future population growth may not be as rapid as that of the 1990s, it is anticipated that Ruidoso will continue to grow rapidly.

The New Mexico Water Quality Control Commission establishes standards for surface and ground waters throughout the State, and the Commission takes special care to preserve high-quality streams such as the Rio Ruidoso and its tributaries, which cross through Ruidoso. The Commission has designated the Rio Ruidoso as a Coldwater Fishery and a Domestic Water Supply, and the commission therefore holds the Rio Ruidoso to an especially high standard of water quality.

Ruidoso is faced with an expanding population, a high transient population, and high water quality standards for the Rio Ruidoso and its tributaries. In combination, these represent a challenge to Ruidoso in terms of wastewater management. The expanding population will soon overwhelm Ruidoso's existing wastewater facilities, which are not intended to meet all of the regulations to which they are currently subject. Ruidoso must develop a comprehensive plan to accommodate both the expanding flows and the current regulations.

The Ruidoso Regional Wastewater Treatment Joint Use Board is responsible for wastewater management in the Village of Ruidoso, the City of Ruidoso Downs, and an area surrounding the Carrizo Lodge, as described in Chapter 2. This preliminary engineering report (PER) refers to the area managed by the Joint Use Board as Ruidoso.

## 1.2 Report Objectives

This report provides a comprehensive plan for the management of Ruidoso wastewater flows, starting at present and extending through the year 2030. This 25-year planning period is considered optimal, and it exceeds the NMED minimum 20-year planning period. The plan shall:

- Describe the planning area, which includes the Village of Ruidoso, The City of Ruidoso Downs, and an area around the Carrizo Lodge. Include an accompanying Environmental Information Document.
- Use data from a number of sources to predict wastewater flows within the planning period.
- Describe the regulations governing wastewater discharges within the planning area. Describe how they may change within the planning period.
- Assess Ruidoso's existing facilities with respect to current and future flows and regulations.
- Develop of a list of alternatives for current and future wastewater management, and compare them based on a set of criteria described in Chapter 5.
- Recommend an alternative and provide further analysis.
- Summarize all recommendations, and identify any other special needs Ruidoso may have with respect to wastewater management.

## 1.3 Previous Reports

Previous reports developed for Ruidoso and relevant to this report are as follows.

A. 40-Year Water Plan 2004, Wilson & Company, 2004.

   This report predicts future water supply needs using population and water system data from 1996 through 2003. The forecast period runs from 2004 through 2044. Chapter 4 uses information from this report for future wastewater flow projections.

B. Septage Disposal Facilities Report for the Ruidoso Wastewater Treatment Facilities, Molzen-Corbin & Associates, 2000.

   This report provides an approach for the handling of septage waste delivered to the plant from sources throughout Lincoln County. The report ultimately recommends installation of a second septage treatment facility. Information on this existing plant was obtained from this report.

C. Environmental Information Document for Wastewater Sludge Land Application Program, Molzen-Corbin & Associates, 1995.

   This report recommends continuation of the plant sludge land application program in place when the report was issued. It provides environmental and other information on the area used for land application, which is near the plant. Information on this existing plant was obtained from this report.

D. Intensive Water Quality Stream Surveys, New Mexico Environment Department, 1993.

   This report contains a water quality survey for rivers and streams throughout New Mexico, including the Rio Ruidoso. Information on the project planning area was obtained from this report.

E. Ruidoso Comprehensive Plan, BRW, Inc., 1984.

This report contains forecasts for population growth and commercial and industrial development. This report was used as an aid in projecting future wastewater flows.

F. Wastewater Facilities Plan, Molzen-Corbin & Associates, 1993.

Information on the existing plant was obtained from this facilities plan.

## 1.4 Report Organization

The format of this report matches that required by the Rural Utility Service for preliminary engineering reports. It can thus be used to solicit loans or grants from the Rural Utility Service, the New Mexico Finance Authority, and the New Mexico Environment Department.

At the end of each chapter is an additional section containing references used in the chapter. The references are numbered, and within the chapter, the references may be cited by superscript.

The report is organized as follows:

Section 1 – General

Summarizes the project background, project objectives, and report organization. Summarizes previous reports done for Ruidoso.

Section 2 - Project Planning Area

Describes the project planning area, including its location, environmental resources, growth areas, and population trends.

Section 3 – Existing Facilities

Describes the existing plant, including its location, history, condition, and financial status.

Section 4 – Need for Project

Justifies the project in terms of regulatory requirements, plant operation and maintenance, and population growth.

Section 5 – Alternatives Considered

Identifies and describes the alternatives considered for project implementation. Includes a no-action alternative for baseline comparison.

Section 6 – Proposed Project (Recommended Alternative)

Recommends an alternative and provides additional description of the alternative.

Section 7 – Conclusions and Recommendations

Provides additional recommendations on how to implement the project.

Appendices

A. Environmental Information Document
B. NPDES Permit
C. Calculations
D. Alternative 1 Conventional Biological Nutrient Removal (BNR) Conceptual Project Costs
E. Alternative 2 Single Basin Nitrification / Denitrification Conceptual Project Costs
F. Alternative 3 Membrane Bioreactors (MBR) Conceptual Project Costs Alternative 1 Cost Estimate Calculations

# 2.0 PROJECT PLANNING AREA

## 2.1 Location and Service Area

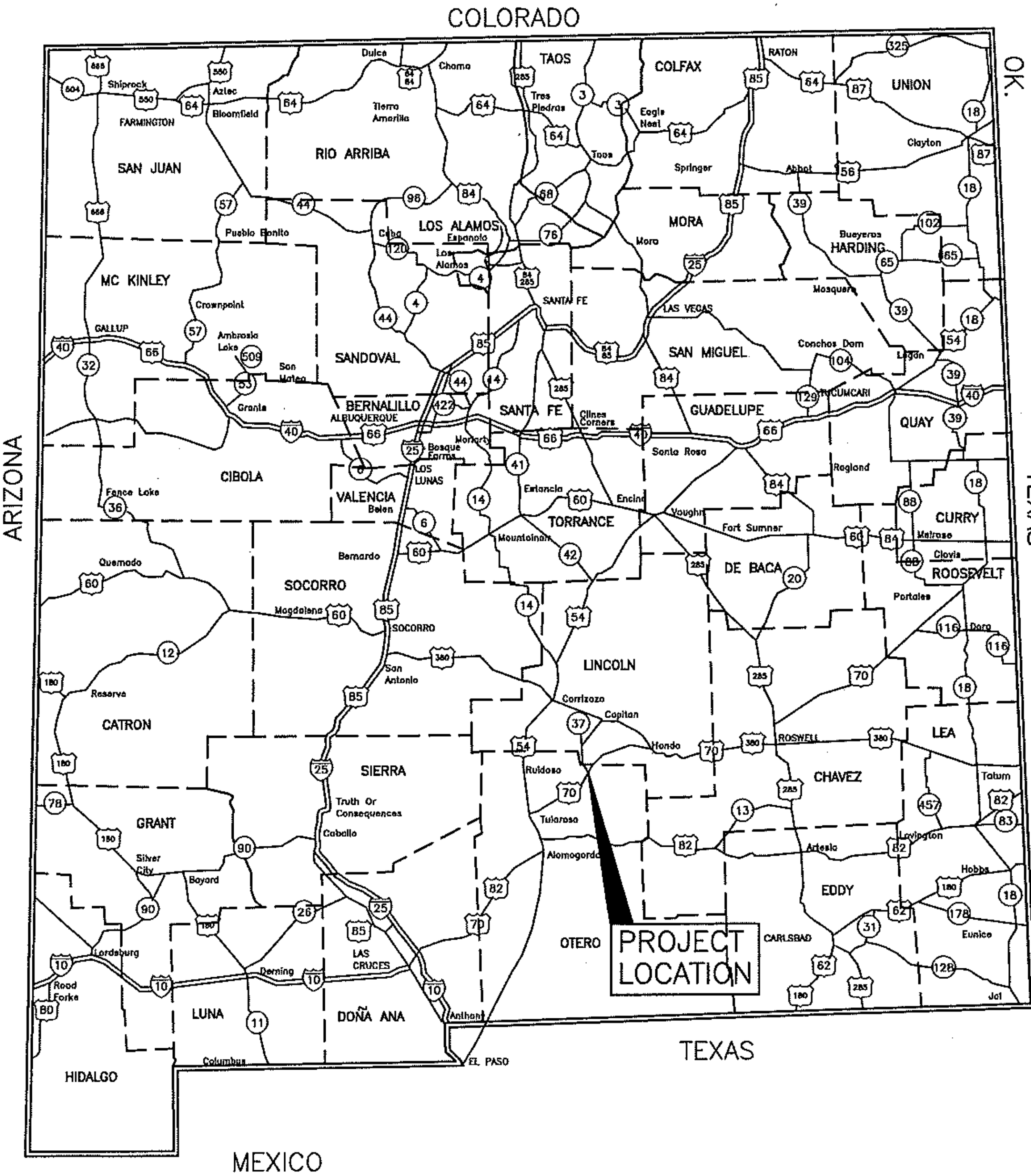
As shown in Figure 2-1, the Ruidoso area is in central Lincoln County, in southern New Mexico, and proximate to several major population centers including Albuquerque, Santa Fe, Alamogordo, Socorro, Tularosa, Roswell, and El Paso, Texas.

Figure 2-2 shows the Planning Area, for which the Ruidoso Regional Wastewater Treatment Joint Use Board manages all wastewater flow. This PER refers to the area as Ruidoso, and the area includes the Village of Ruidoso, the City of Ruidoso Downs, and a strip of land running two miles south of the Village of Ruidoso to the border of Lincoln County. The land runs along Carrizo Creek, including a small neighborhood as well as the Carrizo Lodge.

The population growth potential analyzed herein, as well as the projections of Chapter 4, is based on Census 2000 data for Ruidoso Village, Ruidoso Downs, and Lincoln County.

Ruidoso is in the Sacramento Mountains and is surrounded by the Lincoln National Forest. The elevation reaches 7,000 feet in Ruidoso itself and 10,000 feet in the surrounding mountains. This pristine environment offers numerous outdoor activities such as fishing, hiking, camping, and skiing. Hence, a significant portion of the Ruidoso population consists of transients, who are either tourists or part-time residents. Ruidoso's proximity to major population centers adds to the tourist attraction, and it is thought that transients may double the population of Ruidoso during the summer, which is the peak tourist season for Ruidoso.

As shown in Figure 2-2, U.S. highway 70 passes through the southern and eastern portion of Ruidoso. State Highway 37, also called Sudderth Drive, crosses U.S. 70 in eastern Ruidoso Village near the border with Ruidoso Downs. NM37 is the main street for the Village of Ruidoso and extends through the Village to the west and slightly north, where it turns north into Mechem Drive. The plant is roughly 5 miles east of the U.S. 70/NM 37 intersection, northeast of Agua Fria and north of the Rio Ruidoso.

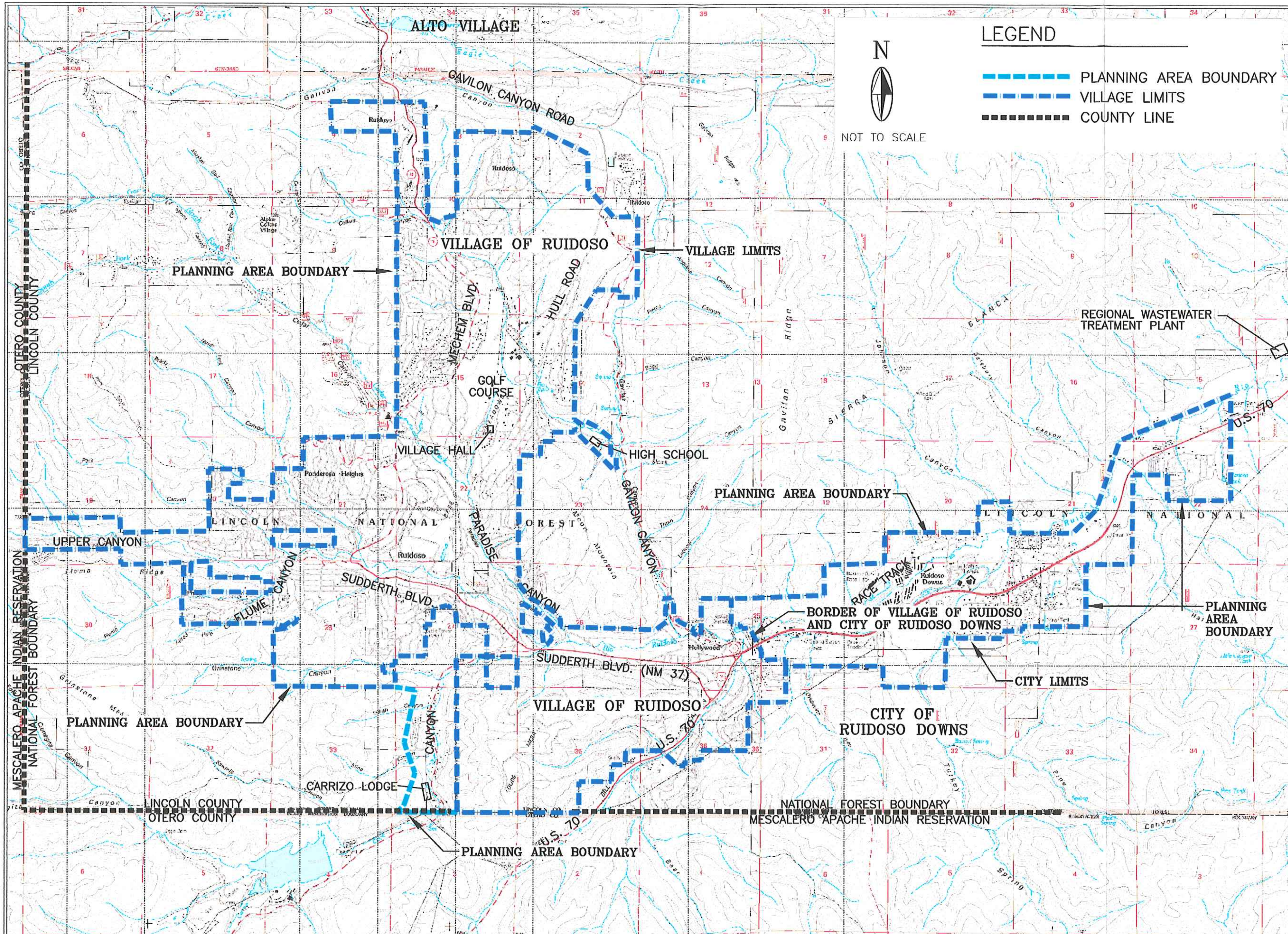



RUIDOSO/RUIDOSO DOWNS

VICINITY MAP

WASTEWATER FACILITIES PLAN AMENDMENT

FIGURE 2-1

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| REV NO | REV DATE | DESCRIPTION |
|---|---|---|

PROJECT NUMBER: RUU71-21
DESIGNED BY: G.D'ARCY
DRAWN BY: JSL
CHECKED BY: G.D'ARCY
PROJ ENG: G.D'ARCY
PROJECT DATE:

PLANNING AREA BOUNDARY

WASTEWATER FACILITIES PLAN AMENDMENT
VILLAGE OF RUIDOSO/RUIDOSO DOWNS, NEW MEXICO

FIGURE 2-2

SHEET

Figure 2-2.dwg 01/10/05

The elevation of Ruidoso results in temperatures that are much lower than the norm for southern New Mexico, and the low ambient air temperatures are important for wastewater planning. Table 2-1 lists the average monthly air temperatures.

**TABLE 2-1**

**RUIDOSO AVERAGE TEMPERATURES IN $^{o}C$**

| Month | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *High* | 9.4 | 11.1 | 13.9 | 18.9 | 23.3 | 28.3 | 27.8 | 26.7 | 25 | 20 | 14.4 | 10.6 |
| *Low* | -7.8 | -7.8 | -5 | -2.2 | 1.1 | 5.6 | 8.9 | 8.3 | 3.9 | -0.6 | -6.7 | -8.3 |

Despite the high elevation and low temperatures, Ruidoso is classified as Sub-Humid Woodland due to the relatively small amount of precipitation. Table 2-2 lists the average monthly precipitation.

**TABLE 2-2**

**RUIDOSO MONTHLY AVERAGE PRECIPITATION IN INCHES**

| Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.1 | 1.1 | 1.4 | 0.8 | 0.9 | 1.8 | 4.6 | 4.2 | 1.9 | 1.2 | 0.6 | 1.3 |

As shown in Table 2-1, Ruidoso has cold weather throughout the year, and the average low temperature rarely exceeds 9 °C , even in July. An important consequence of this is that the wastewater temperatures are unusually low. Table 2-3 shows the average monthly wastewater temperatures measured at the Ruidoso Wastewater Treatment Plant in 2004.

**TABLE 2-3**

**RUIDOSO AVERAGE WASTEWATER TEMPERATURES IN $^{O}$C**

| Month | Jan. | Feb. | Mar. | Apr. | May | June | July | Aug. | Sep. | Oct. | Nov. | Dec. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *High* | 12 | 11 | 15 | 15 | 18 | 21 | 22 | 22 | 21 | 20 | 17 | 14 |
| *Low* | 9 | 8 | 10 | 12 | 14 | 20 | 21 | 21 | 20 | 18 | 11 | 11 |
| *Avg* | 11 | 10 | 13 | 13 | 16 | 21 | 21 | 21 | 21 | 19 | 15 | 12 |

The lowest recorded temperature of 8 °C occurred in February 2004, but this is considered an outlying data point. During the winter months, the minimum recorded temperature was generally 10 °C. During the summer months, the wastewater temperature generally rises to 21 °C.

In addition to the expanding population of Ruidoso, and the tightening regulations on discharges to Ruidoso's pristine surface waters, the cold winter temperatures present an additional challenge to the Joint Use Board, whose wastewater facilities must comply with applicable regulations throughout the year. It is generally more difficult to treat municipal wastewater at cold temperatures.

## 2.2 Environmental Resources Present

The Rio Ruidoso and its tributaries comprise most surface water in Ruidoso, and the New Mexico Water Quality Control Commission has classified the river as both a Coldwater Fishery and a Wildlife Habitat. The Commission therefore holds the river to an especially high standard of water quality.

The Rio Ruidoso flows through numerous communities including Ruidoso and the Mescalero Apache Indian Reservation. The river supplies domestic users and a coldwater fishery upstream of U.S. Highway 70

Apart from the Rio Ruidoso and its tributaries, the planning area contains no known environmentally sensitive resources. Additional information on environmental resources in the planning area can be found in Appendix A, which contains the Environmental Information Document.

## 2.3 Population Growth Projection

Planning Period

The planning period for population growth projection starts in 2005 and continues through 2030.

Population Projection Methods

It is difficult to project the population growth for the next 25 years, so this section uses three methods to estimate the rate at which the Ruidoso population may grow.

1. Method 1 uses past population measurements to establish an annual population growth rate. This rate is used to estimate the future population growth that will occur from 2005 to 2030. The population measurements come from the US Census Bureau. The method is referred to as *extrapolation.*
2. Method 2 refers to a population projection previously done for Lincoln County by the University of New Mexico (UNM) Bureau of Business and Economic Research. Method 2 assumes that the growth rate of Ruidoso will be similar to that of Lincoln County. The growth rates predicted by UNM are applied to the Ruidoso population measured by Census 2000, thereby projecting the population through 2030.
3. Methods 1 and 2 project vastly different growth rates through 2030, so an additional method is used to project Ruidoso's future population growth, and the result is compared to the results of Methods 1 and 2. Method 3 uses Census 2000 data on the number of vacant houses and lots in Ruidoso, where a house may be a stand-alone house, condominium, or apartment, and a lot refers to a space where a house may be built. Method 3 calculates what the Ruidoso population would be if all vacant houses and lots were filled with permanent residents. This calculated population is assumed to occur in the year 2030, and then it is compared with population data from Census 2000, yielding a projected future growth rate.

4. Method 3 predicts a growth rate close to that determined by the Census data extrapolation of Method 1, and the rate differs greatly from that yielded by the UNM data of Method 2. Hence, a fourth estimate of future growth is useful. The Village of Ruidoso 40-Year Water Plan of 2004 projects future growth in population and water consumption. For this, the 2004 Plan extrapolates water consumption data taken in the 1990s.

### 2.3.1 Method 1: Extrapolation of Historical Growth Rates

Census data shown in Table 2-4 indicate that Lincoln County, the Village of Ruidoso and the City of Ruidoso Downs have grown rapidly.

**TABLE 2-4**

**LINCOLN COUNTY POPULATION INCREASES**

| Location | 1970 Population | 1980 Population | 1990 Population | 2000 Population | 1990-2000 | |
|---|---|---|---|---|---|---|
| | | | | | Overall Increase (percent) | Annual Average (percent) |
| Lincoln County | 7,560 | 10,997 | 12,219 | 19,411 | 59 | 4.8 |
| Ruidoso Village | 2,216 | 4,260 | 4,636 | 7,698 | 66 | 5.2 |
| Ruidoso Downs | 702 | 949 | 917 | 1,824 | 99 | 7.1 |
| Ruidoso Total | 2,918 | 5,209 | 5,553 | 9,522 | 72 | 5.5 |

Source: Census 2000 Demographic Profile for Ruidoso Village, Ruidoso Downs, and Lincoln County.

The overall population of Ruidoso grew by 72 percent between 1990 and 2000, at an average of 5.5 percent per year.

If it is assumed that the annual Ruidoso growth rate will be 5.5 percent, and that the population in the year 2000 was 9,522, the population predicted for 2005 is 12,470. The population predicted for 2030 is 48,010.

### 2.3.2 Method 2: University of New Mexico Projections

Table 2-5 shows Lincoln County population projections provided by the University of New Mexico (UNM) Bureau of Business and Economic Research. This data is considered meaningful because annual growth rates for Lincoln County and Ruidoso are similar, as shown in Table 2-4.

**TABLE 2-5**

**LINCOLN COUNTY POPULATION PROJECTIONS**

| | Period | | | | | |
|---|---|---|---|---|---|---|
| | 2000-2005 | 2005-2010 | 2010-2015 | 2015-2020 | 2020-2025 | 2025-2030 |
| Compound Annual Average Population Growth Rates (percent) | 2.14 | 1.75 | 1.43 | 1.17 | 0.98 | 0.86 |
| Projected Population at end of Period | 21,798 | 23,792 | 25,556 | 27,100 | 28,466 | 29,715 |

Source: University of New Mexico, Bureau of Business and Economic Research. Released August 2002.

Table 2-5 shows UNM projected growth rate for each five-year period from 2000 to 2030. If these growth rates are averaged, it is shown that UNM predicted an average annual growth rate of 1.0 percent between 2000 and 2030.

If it is assumed that the annual Ruidoso growth rate will be 1.0 percent, and that the population in the year 2000 was 9,522, the population predicted for 2005 is 10,027. The population predicted for 2030 is 12,980.

### 2.3.3 Method 3: Development Potential

Method 1 yielded roughly 5 times the future annual growth rate predicted by Method 2. Hence, to add meaning to the population projections presented herein, it is helpful to use an additional method to project Ruidoso's future population growth, and to compare the result to that given by Methods 1 and 2. This gives us a better idea of the future growth rate that Ruidoso can expect.

Method 3 uses Census 2000 data on the number of vacant houses and lots in Ruidoso, where a house may be a stand-alone house, condominium, or apartment, and a lot refers to a space where a house may be built. Method 3 calculates what the Ruidoso population would be if all vacant houses and lots were filled with permanent residents. This calculated population is assumed to occur in the year 2030, and then it is compared with population data from Census 2000, yielding a projected future growth rate.

Table 2-6 provides Census 2000 data on the number of houses, average number of people per house, and number of vacant houses in Ruidoso, as of the year 2000. Using the number of vacant houses and the average number of people per house, it is shown that the existing housing in Ruidoso could support as many as 25,240 people, if all vacant houses were filled with permanent residents.

**TABLE 2-6**

**POPULATION AT 100 PERCENT OCCUPANCY IN EXISTING HOUSING**

| Location | Total Houses | Occupied Houses | Vacant Houses | People per Occupied House | Population at 100% Occupancy |
|---|---|---|---|---|---|
| Village of Ruidoso | 7,584 | 3,434 | 4,150 | 3 | 22,750 |
| City of Ruidoso Downs | 921 | 680 | 241 | 2.7 | 2,490 |
| Total | 8,505 | 4,114 | 4,391 | - | 25,240 |

Source: US Census Bureau, Census 2000 for New Mexico

Table 2-7 provides data on the number of undeveloped lots in Ruidoso, as of the year 2004. Using the number of lots, and assuming that each lot could support three people, it is shown that the available lots in Ruidoso could support as many as 14,175 people, if all available lots were developed and filled with permanent residents.

**TABLE 2-7**

**EXISTING UNDEVELOPED BUILDABLE LOTS**

| Buildable Lot Location | Total Available Lots | Population at 100% Occupancy 3 Occupants per Buildable Lot |
|---|---|---|
| Undeveloped Buildable Lots within Ruidoso | 1,925 | 5,775 |
| Undeveloped Buildable Lots surrounding Ruidoso | 2,800 | 8,400 |
| Total | 4,725 | 14,175 |

Source: Village of Ruidoso 40-Year Water Plan (2004)

Tables 2-6 and 2-7 show that the vacant houses and undeveloped lots in Ruidoso could support a total population of 39,415 people. If this population is assumed for the year 2030, and if the Census 2000 population of 9,522 is assumed for the year 2000, a future annual growth rate of 4.8 percent is predicted through the year 2030. A population of 12,070 is predicted for the year 2005.

2.3.4 Method 4: Water Use Records

The Village of Ruidoso 40-Year Water Plan (2004) estimates future population and potable water consumption, using water use records from 1991 to 2003. Table 2-8 shows the water use records, which trend upward from 1991 to 1998. From 1991 to 1998, the average annual growth rate was 2.82 percent. From 1999 to 2003, water rationing, drought, and forest fires affected the water consumption, so data for these years is not considered representative. If it is assumed that the annual Ruidoso growth rate will be 2.82 percent, and that the population in the year 2000 was 9,522, the population predicted for 2005 is 10,940. The population predicted for 2030 is 21,930.

**TABLE 2-8**

**RUIDOSO METERED WATER CONSUMPTION 1991-2003**

| Year | Year Monthly Average (gallons) |
|---|---|
| 1991 | 30,013,101 |
| 1992 | 30,802,791 |
| 1993 | 32,592,316 |
| 1994 | 36,694,117 |
| 1995 | 36,942,001 |
| 1996 | 29,984,013 |
| 1997 | 33,089,388 |
| 1998 | 37,489,975 |
| 1999[1] | 36,337,258 |
| 2000[1] | 33,901,880 |
| 2001[1] | 36,098,713 |
| 2002[1] | 35,245,953 |
| 2003[1] | 35,599,769 |

[1] Data was not used due to drought, watering restrictions, and local forest fires.

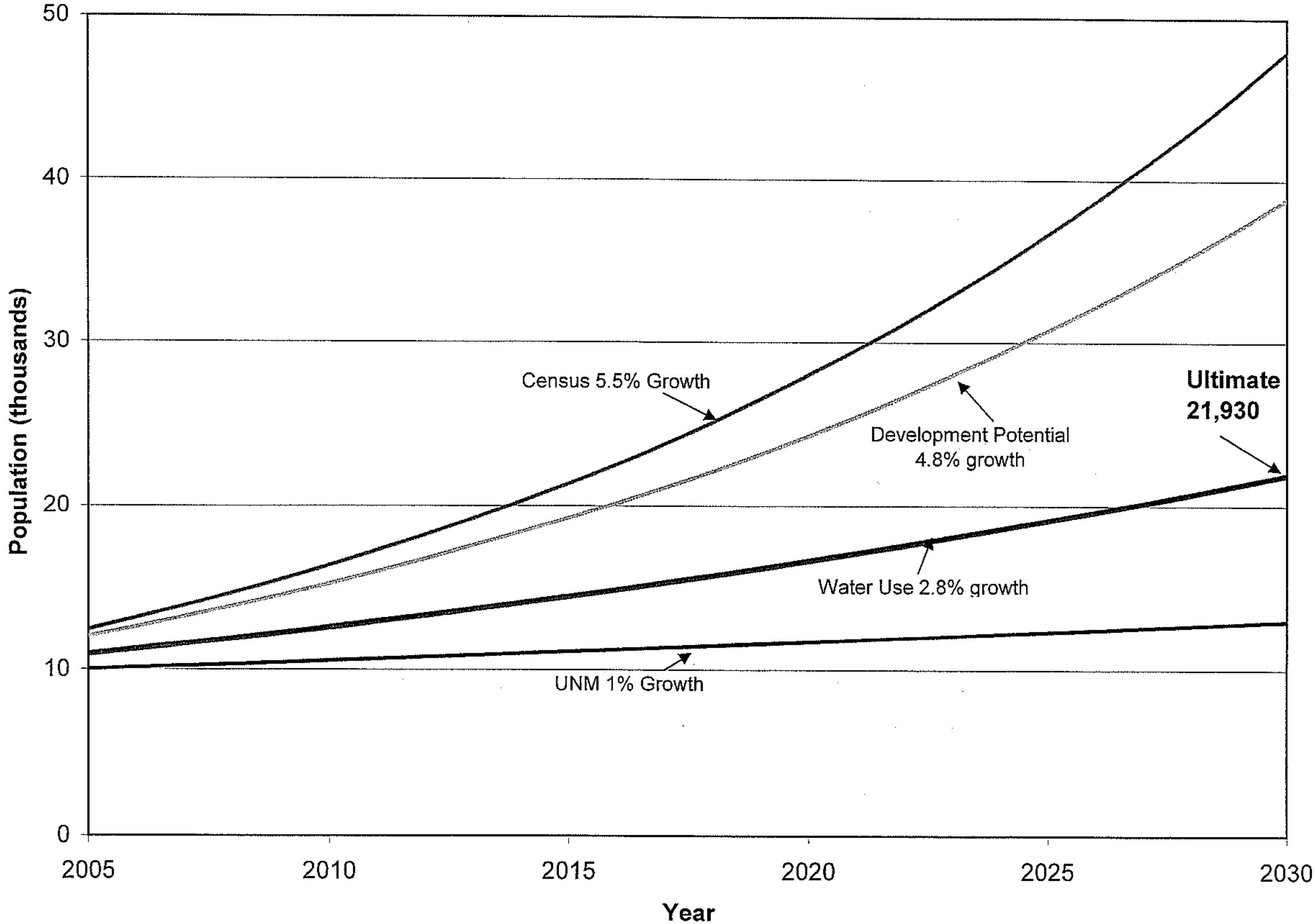
### 2.3.5 Growth Projection Summary

Figure 2-3 summarizes the future population growth projections yielded by Methods 1 through 4. All three apply an estimated growth rate to the Ruidoso population measured by Census 2000, or 9,522.

Method 1 assumes that the rapid growth of the 1990s will continue through 2030. This generous assumption is likely to yield a future annual growth projection higher than that which will actually happen. Method 1 also appears high because it predicts a growth rate higher than can be supported by Ruidoso's development potential.

Methods 2 and 3 provide more realistic approaches, but they differ by a factor of nearly five. The UNM projection is likely to be the minimum growth rate Ruidoso will experience, and the analysis of development potential likely provides the maximum growth rate Ruidoso will experience.

# Figure 2-3
# Summary of Ruidoso Area Population Projections



Method 4, which uses projects population using water use records, provides a future population estimate that is roughly halfway between that of Methods 2 and 3. Hence, the population projection of Method 4 is considered the most reasonable of that provided by the four available methods, and this method is used to project the future population of Ruidoso.

As shown in Figure 2-3, water use records yield a projection roughly halfway between the projections yielded by UNM and by analysis of development potential.

## 2.4 Potential Growth Areas

Due to the mountainous terrain, Ruidoso has developed linearly along the canyon roads and on a number of slopes. Areas of major growth include the following.

*The City of Ruidoso Downs* – The City is home to the Ruidoso Downs Race Track, the Hubbard Museum of the Horse, a Walmart, and residential housing along State Highway 70. The City was originally settled near Hale Spring in the 1930's as a farming and sawmill community. The post office was established in 1947, and the horseracing track soon followed. The City was originally named Palo Verde, but the name was changed to Ruidoso Downs in 1958 to improve name recognition and to highlight the racetrack. Racing events were initially among locals but now include nationally known races like the All American Futurity.

*Mescalero Apache Tribal Lands* – This area contains 720 square miles of mostly forest land located south of Ruidoso in the northern edge of Otero County. Development includes the tribal operated casino and lodging facility.

*Sudderth* – This area contains a number of small businesses, the Lincoln County Medical Center, the Senior Citizen Center, and the intersection U.S. 70 and NM37. The intersection is being rebuilt as part of a project to widen U.S. 70. A number of national retail and lodging chains have been built near the intersection, including Holiday Inn Express, Walgreens, Subway, and Sherwin Williams.

*Midtown* – This is the historic heart of Ruidoso with retail shopping and dining establishments located along Main Street.

*Upper Canyon* – This area is located at the west end of Sudderth beyond the Mechem intersection and contains many of the area older lodging facilities.

*Mechem Drive* – Single-family subdivisions off Mecham Drive (NM 48 Corridor) include Hamilton Terrace, the Country Club area, Cree Meadows and Cree Meadows Heights, Forest heights and Alto Crest. Mechem Drive is zoned continuously for commercial and retail development.

*Gavilan Canyon Drive* – This two-lane road has experienced increased traffic and bottlenecks where it connects to NM37 near U.S. 70. Gavilan Canyon Drive has been suggested in previous transportation studies as an alternate bypass around the Village to reduce congestion on Mechem Drive and Sudderth.

## 3.0 EXISTING FACILITIES

## 3.1 Location Map

Figure 3-1 shows the location of the Ruidoso Wastewater Treatment Plant, which is the sole facility used by the Joint Use Board to manage Ruidoso wastewater flows. Figure 3-2 shows the layout of the existing plant. All Ruidoso wastewater flows drain to this activated sludge plant, which discharges effluent to the Rio Ruidoso.

## 3.2 History

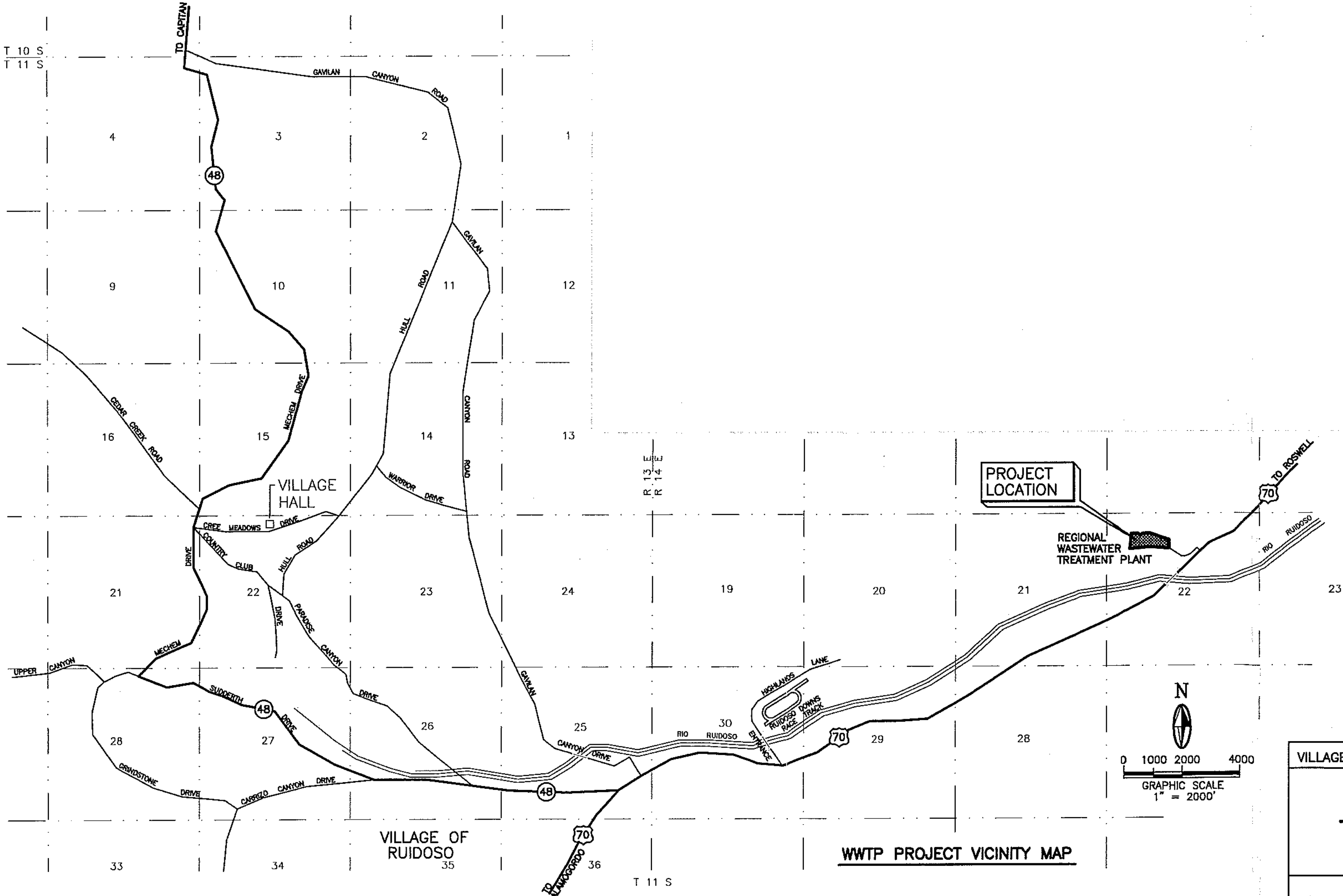
### 3.2.1 Original Plant

The Ruidoso Wastewater Treatment Plant (WWTP) was built in 1978 to treat 0.77 mgd of winter flow, but the Facilities Plan of 1993 rated the plant capacity at 1.9 mgd. Both estimates of plant capacity are based only on the removal of suspended solids, organic carbon, and fecal coliform. The plant has never been designed or rated for biological nutrient removal (BNR).

The original plant consisted mainly of a flow equalization basin, two surface-aerated oxidation ditches, two secondary clarifiers, a chlorination facility, a gravity thickener, an aerobic digester, and sludge drying beds. Influent flow was handled using two open-channel screw pump stations.

Since the plant was built in 1978, it has treated sludge using aerobic digestion and sludge drying beds. Supplemental stockpiling has often been used to provide additional pathogen reduction, solids reduction, and reduction in vector attraction.

Until the sludge drying beds were improved in 1999, the plant made Class B sludge, according to the EPA classifications described in Section 3.2.3. The sludge was originally applied to a 15-acre tract of land between the plant and the river, but NMED required Ruidoso to discontinue this practice in 1996, due to concerns over proximity of the sludge to the river. Between 1996



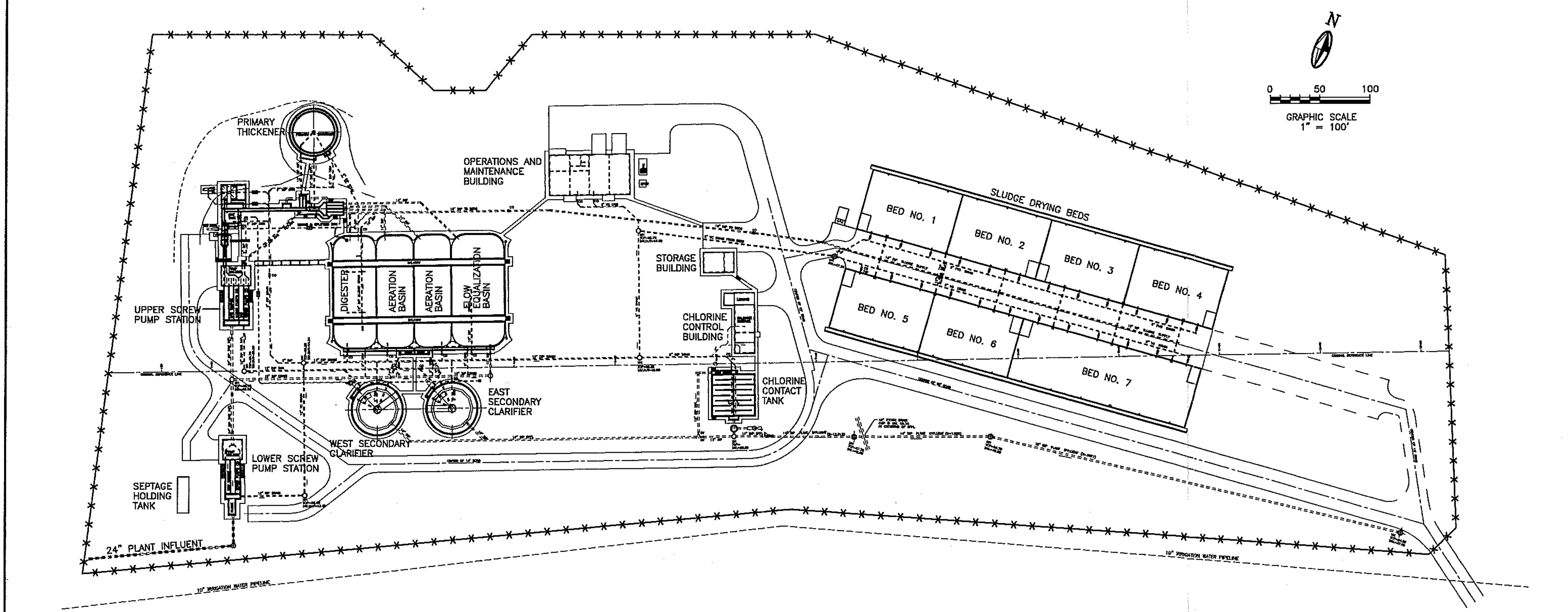

VILLAGE OF RUIDOSO NEW MEXICO

**FIGURE 3–1**

**TREATMENT PLANT LOCATION**

MOLZEN–CORBIN & Associates

ENGINEERS ▲ PLANNERS ▲ ARCHITECTS




VILLAGE OF RUIDOSO — NEW MEXICO

**FIGURE 3-2**

**EXISTING TREATMENT PLANT FACILITIES AND SITE PLAN**

MOLZEN-CORBIN & Associates

Figure 3-2 1=100 01/11/05 RUI21-71

and 1999, all sludge that was removed from the site was taken to the Gandy Land Farm near Tatum, New Mexico.

### 3.2.2 Recent Improvements

In 1989, Ruidoso installed a sulfur-dioxide dechlorination system without the help of an engineer. In 1999, Ruidoso converted the primary clarifier to a sludge thickener, and it is currently used prior to aerobic digestion.

In 1999, a project designed by Molzen-Corbin & Associates replaced the screening and grit removal facilities at the plant. The project modified the sludge drying beds and carried out other minor improvements.

In 1999, improvements to the sludge beds enabled the production of Class A sludge. Moreover, a windrow turner purchased in 2001 enabled the conversion of the sludge stockpiles into compost heaps. All sludge produced since 1999 has been Class A, and none has been removed from the site. The Board is currently negotiating with a nearby landowner who has obtained approval from NMED to combine plant sludge with solid waste from the Ruidoso Downs track. The landowner intends to compost the combined waste, and he can accept either Class A or Class B sludge from the plant.

The plant improvements and modifications performed between 1989 and 1999 were not intended to increase the overall plant capacity. They were intended to enhance operability and performance with respect to the permit in place at the time. Hence, the capacities given by the original designers and by the Facilities Plan of 1993 do not apply to the current permit, which this Section discusses further.

### 3.2.3 Changes in Permit Requirements

The permit governing the plant effluent has been changed since the plant was originally built in 1978.

Permitting in General

The United States Environmental Protection Agency (EPA) regulates the discharge of treated wastewater to natural surface waters. EPA sets effluent quality standards and describes them in discharge permits issued through the National Pollutant Discharge Elimination System (NPDES).

Wastewater discharge permits generally regulate the following parameters, though not all may be included in a permit:

- Five-Day Biochemical Oxygen Demand (BOD).
- Total suspended solids (TSS)
- Fecal coliforms
- Total Residual Chlorine (TRC)
- Ammonia Nitrogen ($NH_3$-N)
- Total Kjeldahl Nitrogen (TKN), which is a measure of all organic nitrogen, including ammonia nitrogen.
- Total Nitrogen (TN), which includes both ammonia nitrogen and nitrate.
- Whole Effluent Toxicity (WET), which is a pass/fail test described in the permit. It measures the lethality of the wastewater to permit-specific organisms, such as Pimephales promelas (the Fathead Minnow).
- Total Phosphorus
- pH
- Dissolved Oxygen (DO)

Almost all plants are required to meet standards for BOD, TSS, and fecal coliforms. Some plants are required to meet nitrogen or phosphorus standards, and this is normally accomplished through biological removal of ammonia, nitrate, or phosphorus. Chemical treatment may also be required in cases where the effluent phosphorus standard is below 1 mg/l.

Often a permit requires nitrogen removal indirectly. For instance, a permit may specify that a Whole Effluent Toxicity (WET) test be performed on an organism that is sensitive to ammonia. In such cases, the WET test requires biological removal of ammonia, or *nitrification.*

The stringency of a permit, or the degree to which it regulates an effluent discharge, depends on the regulations governing the quality of the receiving stream. In general, cleaner receiving streams are subject to more stringent quality requirements, and the discharges to them therefore have more stringent permits.

The New Mexico Water Quality Control Commission (WQCC) establishes quality standards for surface waters throughout New Mexico, and these standards often depend on a set of classifications that the Commission applies to surface waters. These classifications include Coldwater Fishery, High-Quality Coldwater Fishery, Domestic Water Supply, Irrigation, and Intermittent Stream.

The stringency of a standard that the Commission applies to a river may drive EPA to establish a more stringent permit for a discharge to that river.

The Code of Federal Regulations (CFR), administered by the EPA, governs the management of municipal wastewater sludge, which it refers to as biosolids. Until 1993, the regulations were found in Title 40, Part 257 (40 CFR 257). Since 1993, 40 CFR 503 has governed. Both are essentially the same with regard to surface disposal, which is the preferred method of sludge disposal. For land application, the Code requires that sludge be Class A or Class B. Sludge is Class A if pathogens are not detectable. Sludge is Class B if pathogens are detectable but beneath harmful concentrations. The Class of sludge can be determined by direct measurement of pathogen concentrations, or by other methods described in the Code. Surface disposal of Class A sludge is essentially unrestricted. Where Class B sludge is land applied, the application area must be monitored as described in the Code.

The Code also requires that the vector attraction of surface-disposed sludge be reduced, and it gives several alternatives for reducing this attraction. Vectors are organisms, like rodents or insects, that may be attracted to insufficiently treated sludge.

Rio Ruidoso Quality Standards

From 1998 to 2000, the WQCC reviewed its surface water standards and revised the standard for Segment 208 of the Rio Ruidoso, to which the WWTP discharges. Table 3-1 describes the revised stream standard.

**TABLE 3-1**

**NM STREAM STANDARD SUMMARY – RIO RUIDOSO**

| | |
|---|---|
| Section 20.6.4.208 | Pecos River Basin – Perennial reaches of the Rio Penasco and its tributaries above state highway near Dunken, perennial reaches of the Rio Bonito downstream from state highway 48 (near Angus), the Rio Ruidoso downstream of the U.S. highway 70 bridge near Seeping Springs lakes, perennial reaches of the Rio Hondo, and Agua Chiquita. |
| Designated Uses | Fish culture, irrigation, livestock watering, wildlife habitat, coldwater fishery, and secondary contact. |
| Standards[1] | (1) In any one sample: pH shall be within the range of 6.6 to 8.8, temperature shall not exceed 30 °C (86 °F) and total phosphorus (as P) shall be less than 0.1 mg/L. |
| | (2) The monthly geometric mean of fecal coliform bacteria shall not exceed 200/100 mL; no single sample shall exceed 400/100 mL. |

[1] Additional standards (20.6.4.900 NMAC) are applicable to the designated uses.

As shown, the river has an exceedingly stringent phosphorus limit, possibly as a result of an environmental analysis that cited phosphorus as the limiting nutrient in the growth of downstream algae. The pristine, high-mountain nature of the river may also have driven the phosphorus restriction.

Revised WWTP Permit

EPA Region 6 regulates the WWTP discharge according to NPDES Permit No. NM0029165. In November 2000, EPA revised the permit to reflect the newly revised standards for the Rio Ruidoso. Table 3-2 describes the revised permit, for which EPA set a compliance deadline of January 2004. Appendix B contains a full copy of the permit.

**TABLE 3-2**

**RUIDOSO WASTEWATER TREATMENT PLANT –NPDES PERMIT LIMITS (JANUARY 1, 2001 – AUGUST 31, 2007)**

| Effluent Characteristics | Discharge Limitations | | | |
|---|---|---|---|---|
| | kg/day (lbs/day) 30-day Average | Other Units (Specify) | | |
| | | 30-day Average | 7-day Average | Daily Maximum |
| Flow | N/A | Report (mgd) | N/A | Report (mgd) |
| Biochemical Oxygen Demand (5-day) | 295 (650) | 30 mg/l | 45 mg/l | N/A |
| Total Suspended Solids | 295 (650) | 30 mg/l | 45 mg/l | N/A |
| Fecal Coliform Bacteria (Colonies/100 mL) | N/A | 500 | 500 | |
| Cyanide (Weak acid dissociable) | 0.06 (0.13) | 6.07 μg/l | N/A | 9.1 μg/l |
| Mercury (Total) | 0.00021 (0.00046) | 0.021 μg/l | N/A | 0.014 μg/l |
| Phosphorus | 1 (2.2) | 0.1 mg/l | N/A | 0.15 mg/l |
| Vanadium (Total) | Report | Report (μg/l) | N/A | Report (μg/l) |
| Whole Effluent Toxicity | 7-Day Chronic NOEC Freshwater | | | |
| Species | Ceriodaphnia dubia, Pimephales promelas | | | |
| Critical Dilution | 57% | | | |

Additional requirements are:

- No detectable chlorine in effluent.
- pH between 6 and 9, measured with same frequency as TSS.
- No discharge of floating solids or visible foam in other than trace amounts.
- Comply with 40 CFR 503 on biosolids management.

## 3.3 Permit Issues

As shown in Table 3-2, the plant discharge has a phosphorus limit of 0.1 mg/l, which is considered an extremely stringent limitation for a wastewater effluent. Moreover, a comparison of Tables 3-1 and 3-2 shows that the effluent phosphorus standard is the same as that for the Rio Ruidoso itself, indicating that the permit does not allow for any dilution of effluent in the river.

New point sources throughout the Rio Ruidoso basin add phosphorus to the river, and the Joint Use Board proposed to reduce or eliminate non-point sources, then limit the plant effluent to a standard that can be achieved by biological treatment alone.

During the preparation of this PER, Ruidoso investigated the possibility of an increase in the effluent phosphorus limit to 1.0 mg/l utilizing a "Water Quality Trading Program" to reduce or eliminate non-point source discharges of phosphorus to the Rio Ruidoso in exchange for the increased effluent limit. A consultant was retained to investigate the potential of the proposed Water Quality Trading Program, and it was concluded that such a program lacked the necessary trading potential on this segment of the Rio Ruidoso. As such, the 0.1 mg/l effluent phosphorus limit is in effect and compliance with this limit will be required. Consequently, despite occasional references to a 1.0 mg/l effluent phosphorus limit, this PER should be understood as reflecting Ruidoso's commitment to construct and operate a plant capable of meeting the required 0.1 mg/l effluent phosphorus limit.

Since the 1.0 mg/l phosphorus effluent limit was being studied during the preparation of this PER, the PER has been prepared to address both a 1.0 mg/l and 0.1 mg/l phosphorus limit. This PER presents a plan for installation of a biological treatment process capable of reducing plant effluent phosphorus to 1.0 mg/l. The PER further presents a tertiary chemical process that is installed downstream of the activated sludge process to achieve the required phosphorus limit of 0.1 mg/l.

The permit requires that the WET test be passed using two sensitive organisms - Ceriodaphnia Dubia and Pimephales Promelas. It is thought that nitrification will be required to pass this test, which is currently not being conducted as required by the permit.

## 3.4 Condition of Facilities

### 3.4.1 Permit Compliance

The plant currently meets the permit standards for effluent $BOD_5$, TSS, TRC, and fecal coliform. The existing plant meets permit requirements for biosolids management. Tests taken in 2000 suggest that the plant complies with cyanide and mercury discharge requirements, but these two contaminants should be tracked over time to ensure continued compliance. This report does not address the issue of controlling cyanide or mercury in the plant effluent.

The existing plant does not comply with permit standards for effluent phosphorus. The current permit requires an effluent concentration no greater than 0.1 mg/l. The current effluent phosphorus concentration is roughly 2.4 mg/l.

The WET test is not being performed, which constitutes further noncompliance with the permit. It is assumed that nitrification would be required for compliance with the WET test, and the plant is not designed for it. Hence, it would most likely fail the WET test if it were performed.

### 3.4.2 Capacity vs. Current Flow

The plant capacity was estimated by the original designers and again for the Facilities Plan of 1993. Both estimates were based on the permit in force at the time. The capacity of the plant is re-evaluated with respect to the current permit and assuming that the WET test will require nitrification. It is further assumed that part of the aeration volume of the existing plant is modified for anaerobic operation.

It is the experience of the engineer that a nitrification plant, operating at a temperature around $10^{\circ}$ C, needs roughly 30 hours for nitrogen removal.

The capacity of the two treatment basins totals 680,000 gallons, so the capacity of the existing plant is theoretically 0.544 mgd, and the average daily winter flow is 1.24 mgd. Hence, the existing plant is theoretically overloaded by roughly 0.70 mgd with respect to the current permit.

If the existing digester and equalization basins were also converted for wastewater aeration, the total aeration volume would be roughly 1.4 MG. In theory, the plant capacity would be 1.12 mgd, which is less than the current flow to the plant.

Plant operators report maximum 2-hour peaking factors of 2.0 and 2.6 for winter and summer holidays, respectively. Hence, the maximum instantaneous flow currently applied to the plant is roughly 3.2 mgd. In theory, according to the rated firm capacity of the influent lift stations, the plant is hydraulically able to accept this peak flow. However, flow does pool in the influent channel, leading to inaccuracy of the influent Parshall flume, and this suggests that the influent pumps are not lifting a sufficient amount of flow.

### 3.4.3 Necessity of Plant Expansion

Given Ruidoso's increasing population, and the inability of its facilities to comply with federal regulations, it is evident that the existing treatment plant must be expanded and modified for phosphorus and ammonia removal. This is explored in Sections 4 and 5. This Section focuses on evaluating Ruidoso's existing wastewater management facilities with respect to the current permit and the certainty of substantial population growth in Ruidoso.

### 3.4.4 Plant Components

A plant assessment was conducted to determine the condition of the existing treatment units and components. Table 3-4 summarizes the findings and recommends improvements or repairs necessary for continued plant operation.

The capacities of some existing components are evaluated using references listed in Section 3.5 and cited by superscript within the text. Where a capacity depends on peak flow, the maximum reported peaking factor of 2.6 is used.

Because a plant expansion is necessary for treatment of future flows and compliance with the existing permit, Table 3-3 evaluates the suitability of some plant components for reuse in an expanded plant.

## 3.5 Initial Recommendations for Plant Expansion

Table 3-3 evaluates the individual plant components, concluding that some may be suitable for reuse in an expanded plant, and others should not be reused. Some of these recommendations require more detailed explanation.

### 3.5.1 General Comparison of Construction Staging vs. New Land Acquisition

To explain why it is necessary to acquire additional land, it is helpful to start with a hypothetical scenario.

When a wastewater treatment plant is expanded, it is essential that treatment of the incoming wastewater continue during construction, and this often presents challenges in terms of plant construction. For example, suppose it is desired to replace an activated sludge process, which consists of an aeration basin and a clarifier. Suppose it is desired to put the new process in the location occupied by the existing process. It is not possible simply to demolish the existing process and let raw sewage flow to the river while the new process is built. Rather, it is necessary to build the new process in a location other than the existing process. When the new process is finished, the incoming wastewater can be routed to the new process, and the existing process can be taken offline. Once offline, the existing process can be abandoned, fully demolished, or demolished to ground level and covered with new ground. The latter is

## TABLE 3-3

## SUMMARY OF CONDITION OF EXISTING TREATMENT UNITS AND COMPONENTS

| Description | Size/Capacity | Year Built | Present Condition and/or Comments | Recommendations for Continued Use |
|---|---|---|---|---|
| Plant Site | 13.3 acres | N/A | Limited in space, mostly due to the presence of the four main basins, which occupy much surface area due to their shallow depth. Much of the ground is at low elevation, and much is difficult to use due to the steep terrain. | Ideally, new land should be acquired, and portions of the expanded plant should be built on new land. Two acres west of the plant should be sufficient. Otherwise, the limited space of the existing site may require staged construction of the expanded plant. |
| Influent Metering Station- Parshall Flume at Lower Lift Sta. | 12" throat width | 1978 | Good Condition, but does not totalize. Sometimes floods due to downstream obstruction. | Suitable for reuse, depending on future plant layout. |
| Lower Influent Lift Station and Building | Three 36" dia. pumps, 15 HP, 1800 gpm each 20' by 20' building | 1978 | Poor Condition. The rusted pumps have been running for longer than their intended service life of 25 years. Difficult to get spare parts. Building is in fair condition. | Replace lift station. Building may be used for storage, depending on future plant layout. |
| Influent and RAS Lift Station and Building. | Three 36" inlet pumps, 15 HP, 1800 gpm each. Two 36" RAS pumps, 15 HP, 1600 gpm each 19' by 29' building | 1978 | Poor Condition. The rusted pumps have been running for longer than their intended service life of 25 years. Difficult to get spare parts. Building in fair condition. | Replace lift station. Building may be used for storage, depending on future plant layout. |
| Mechanical Bar Screen with Screenings Conveyor | Channel width: 2'-8", Channel depth: 4'-3", Screen opening: ½", Screen incline: 80 deg. | 1999 | Good Condition. Maximum capacity is roughly 6.5 mgd (2-hour peak) assuming max intra-bar velocity of 3 fps[4] and 33 percent clogging. This allows design flow of 2.2 mgd. | Continued use is not recommended. The capacity appears insufficient for future flows, and the large bar spacing may be problematic if centrifuges, belt presses, or membrane biological reactors (MBR) are installed downstream. Most modern screens have inter-bar spacing of 1/4th inch at most. |
| Manual Bar Screen for Bypass | ¾" spacing between bars | 1999 | Good Condition | Continued use is not recommended. As with the existing main bar screen, the large bar spacing may be problematic, and the screen appears inadequate for future flows. |
| Grit Removal System | Basin: 14'x14'x 18.5'D Volume: 28,200 gal | 1999 | Good Condition. Manufacturer allows for max design flow of 2.0 mgd. Equipment in good condition, but positive-displacement blower is loud. | Continued use is not recommended due to low capacity. Grit classifier may be salvageable. |

| Description | Size/Capacity | Year Built | Present Condition and/or Comments | Recommendations for Continued Use |
|---|---|---|---|---|
| Mixing and Splitting Structure, flumes. | N/A | 1978 | Poor Condition | Continued use is not likely, as it would be clumsy and difficult. |
| Aeration Basins | Two, 36.5' x 110', 12" SWD; 340,000 gal. ea. | 1978 | Poor Condition<br>Questionable structural integrity.<br>Insufficient capacity. | Continued use is not recommended. The basins are already overloaded, in theory, with respect to the current permit. They are certainly not large enough for future flows, even in combination with other basins. The structural integrity of the basins is questionable. Shallow depth and surface aeration can further lower the water temperature during the cold months, reducing the reaction rate. |
| Aeration Basin Brush Rotor Aerators | Eight total, four in each basin, 39" dia. x 15', 60 HP motor drives for two brushes | 1978 | Poor Condition. Brushes are insufficient to keep deep solids suspended, so solids accumulate in the basin. Beneath the rotors, solids have accumulated to a 3-foot depth, reducing basin capacity. An aerator has detached and fallen into Basin 1. Aerators are old. | Not recommended for reuse, because aeration basins are not recommended for reuse. |
| Equalization Basin | One, 52.4' x 110', 8' SWD; 330,000 gallons | 1978 | Good Condition | Reuse is not recommended, because an expanded plant would be designed so as not to require equalization, and the basin is not useful for anything else due mainly to its shallow depth and low aeration capacity. It is also part of the same structure that holds the aeration basins, which are not recommended for reuse. |
| Flow Equalization Brush Rotor Aerator | Two, 39" diameter x 15', 30 HP each | 1978 | Good Condition, but one aerator is broken. Structure is of questionable integrity. | Not recommended for reuse, because equalization basin is not recommended for reuse. |
| Secondary Clarifiers | Two, 50' diameter, 12' SWD, mechanism with 1 HP drive | 1978 | Poor Condition<br>Depth is less than NMED minimum of 16 ft. Ice buildup on wall interferes with drive wheel. Salt used for ice control corrodes concrete. Structural integrity is suspect. Short circuiting in east clarifier. Combined capacity of 1.4 mgd, which is not adequate for future flows. | Must not be reused as secondary clarifiers. Should be abandoned but not demolished. They may be useful for chemical phosphorus removal, if structural analysis shows them to be sound. |

| Description | Size/Capacity | Year Built | Present Condition and/or Comments | Recommendations for Continued Use |
|---|---|---|---|---|
| Aerobic Digester | One, 42'x110'x12' SWD; 390,000 gallons | 1978 | Poor Condition. Aerators are at a fixed height, so the liquid level drops below the aerators when water is wasted and/or decanted. The sludge then goes without aeration. Structure is of questionable integrity. | Reuse is not recommended. For reuse, this basin would require retrofit with new, floating aerators. Shallow depth makes the basin more vulnerable to cold weather, and surface aeration further reduces water temperature, leading to slower digestion. Basin is part of the same structure that holds the aeration basins and equalization basins, none of which are recommended for reuse. |
| Aerobic Digester Brush Rotor Aerators | Four, 39" diameter x 15', 60 HP motor drives for two brush rotors | 1978 | Poor Condition<br>Water level often falls below the fixed aerators, hindering aerobic digestion and leading to a hard surface coating. Aerators are old. | Not recommended for reuse, because the existing digester is not recommended for reuse. Moreover, the height is fixed, which does not allow for basin drawdown. |
| Sludge Thickener | One, 40' diameter, 8' SWD, 1 HP motor on mechanism | 1978 | Poor Condition<br>Converted from Primary Clarifier to Sludge Thickener in 1999. Thickens WAS. Drive is broken and can only be fixed at great expense. Ice accumulates atop the basin wall and would interfere with the drive, if the drive worked. Sidewalks are settling. Weir plates in good condition. Capacity is adequate.[4] | Reuse is not recommended. Repair would be expensive, and the thickener would still have problems after being prepared. Thickener occupies high ground that may be more useful for new modules. Alternatives to gravity thickening may be preferable. |
| Effluent Metering Manhole Structure with Parshall Flume | 12" throat width | 1999 | Good Condition | Reuse is possible, depending on future plant hydraulics. |
| Chlorine Contact Basins | Two basins: 40'x40'x10' SWD; 58,000 gallons each | 1978 | Poor Condition<br>Center wall leaks, and integrity of structure is highly suspect. Min contact time is 30 min[4] at design flow, allowing a maximum design plant flow of 2.8 mgd. Capacity appears adequate. | Reuse is possible, depending on future plant hydraulics. For reuse, the leaking center wall would have to be fixed, and the structure would have to be checked for soundness. Reuse is not likely because the operators seek to move away from treatment with hazardous chemicals. A switch to ultraviolet disinfection is likely. |
| Chlorine Control Building | 19'x18' (342 sqft) Two chlorinators with auto switchover. Each is 100 ppd and expandable to 500 ppd. | 1978 | Good Condition | Reuse is possible if the Joint Use Board continues to disinfect using chlorination and dechlorination. |

| Description | Size/Capacity | Year Built | Present Condition and/or Comments | Recommendations for Continued Use |
|---|---|---|---|---|
| Dechlorination Building | 10'x5' Building<br>Two dechlorinators with auto switchover. Each supplies 50 ppd of $SO_2$. | 1989 | Good Condition | Reuse is possible if the Joint Use Board continues to disinfect using chlorination and dechlorination. |
| Sludge Drying Beds | 5 beds, 90'x60' each<br>1 bed, 180'x60' | 1978 | Good Condition, but insufficient capacity and periodic odor generation.<br>Converted from sand beds to paved beds in 1999. Insufficient drying area, which hinders sludge wasting. | Either additional beds must be added, or the system must be replaced with a mechanical system. It is unlikely the site has enough area to accommodate the proper number of additional beds for present and future flows. |
| Operation and Maintenance Building | 40'x80' (3,200 sqft) | 1978 | Fair Condition.<br>Insufficient room for record keeping. Some roof leakage. Electrical room is used for a lunch room and a conference room. Has no women's bathroom. Laboratory is in good condition, but not sufficiently equipped. | Building should not be modified, because any modifications would require that it be brought into compliance with current building codes. Rather, a second building should be built next to the existing building, and the new building should have a women's washroom, new laboratory, and possibly a new control station. |
| Emergency Generator | 750 kw | 1978 | Good condition.<br>Diesel engine. | Reuse is possible, depending on total electrical load of expanded plant. |

preferable because it is much less expensive than full demolition, and it leaves the site less cluttered.

Now suppose that there is not enough spare land for building the new process. Suppose there is only enough spare land for building a new aeration basin. In this instance, the construction must be *staged*. The first stage would be to build a new aeration basin in the available space. The incoming wastewater would be routed to the new aeration basin, and then to the existing clarifier, thus maintaining full treatment of the wastewater. The existing aeration basin would be taken offline and demolished completely, all the way to the base slab. The second stage would be to build a new clarifier in the space previously occupied by the demolished aeration basin.

The aeration basin flow is then routed to the new clarifier. The existing clarifier is either abandoned, demolished to ground, or fully demolished.

In the above hypothetical scenario, the staged approach is discouraged, because the construction takes longer and costs more. Also, the cost of demolishing the aeration basin is higher, because it must be completely demolished all the way to the base slab

### 3.5.2 Acquisition of New Land for Ruidoso WWTP

For construction of an expanded plant, it is highly recommended that Ruidoso acquire additional land. A small amount of land, in combination with the space available on the existing plant site, would allow Ruidoso to build the entire plant expansion without disturbing the existing process. Moreover, Ruidoso would save a great deal of money on demolition costs, since abandoned modules would be demolished to ground level and covered with new ground.

Unless new land is acquired, the plant will most likely require staged expansion, because the existing site has very little free space. Construction staging will cost more due to longer construction time and the greater amount of work necessary. It will also increase demolition costs, since some modules will require complete demolition, allowing new modules to be built in the previously occupied space.

### 3.5.3 Influent and RAS Pump Replacement

Table 3-3 recommends that both the low and high influent lift stations, as well as the RAS lift pumps, be demolished and replaced. The screw pumps that make up these stations are severely rusted, and they have run beyond their intended 25-year service life. Due to the age, it is difficult to get replacement parts.

Combination of both influent stations into a single submersible pump station would make better use of space and would allow for the use of variable-frequency drives, if needed.

It is stated unequivocally in Table 3-3 that the secondary clarifiers should not be reused as secondary clarifiers, and that new secondary clarifiers are needed. Replacement of the RAS station would allow for the new RAS station to be placed near the new secondary clarifiers, thus allowing for less gravity RAS flow and more pumped RAS flow.

### 3.5.4 Replacement of Secondary Clarifiers

New secondary clarifiers are needed for proper plant operation. The existing clarifiers currently allow the carryover of scum, grease, and solids, and this adversely affects the effluent quality.

Both clarifiers use a peripheral drive, which rolls a tire atop the basin wall, where snow and ice inevitably gather and interfere with the mechanism. To remove the ice, the operators use salt, which corrodes the concrete. Since it is necessary to remove the ice, and since salt is the only feasible way to do it, the basins will sustain more corrosion damage during the winters.

The drive mechanisms are old and likely to fail. A similar drive mechanism on the thickener has already failed, and it has not been repaired due to the associated expense.

The east clarifier has settled such that water flows unevenly over the effluent weir plates. The operators have adjusted the weirs as far as possible to offset the short-circuiting, but the short-circuiting continues. To stop the short-circuiting, one would have to level the structure using pressure grout or some other method. The attempt would be expensive, and it may be unsuccessful or cause damage to the structure, which was built in 1978.

Although the clarifiers should not be reused as clarifiers, neither should they be demolished. These basins may be useful for chemical phosphorus removal.

### 3.5.5 Estimation of Expanded Plant Capacity

Future flows are projected in Section 4, but for purposes of discussion, it is assumed for Section 3.5 that the plant may be expanded to 2.5 mgd. This is a fair estimate given the existing plant flows and the population projections presented in Section 2. Where evaluation of a plant component requires the use of peak flow, the maximum recorded peaking factor of 2.6 is used.

### 3.5.6 Aeration/Digestion/Equalization Structure

Although reuse of the modules in this common structure is possible, it is not recommended. The aeration, digestion, and equalization modules are all part of a common structure, so reuse of one module entails reuse of them all, since it would be imprudent to remove part of an already cracked structure, and one wouldn't want to occupy valuable plant space with an unused basin. All modules are of questionable utility, for the following reasons:

- As stated in Section 3.4.2, nitrogen removal is needed for compliance with the permit currently in place, and this requires a winter detention time of roughly 30 hours. At 2.5 mgd, the existing aeration basins would provide 6.5 hours of detention time, or about 1/5$^{th}$ of the required detention time. If the equalization basin and aerobic digester were converted for aeration and combined with the existing aeration basins, the four basins together would provide 13 hours of detention time, or slightly under half of that required.
- If a parallel activated sludge process were added to supplement the existing process, which would require the use of all four basins on the existing structure, the new process would be based on surface-aerated oxidation ditches, since the new process would have to be similar to the existing process.

- For a climate such as that of Ruidoso, oxidation ditch technology is not preferred. The basins are shallow and use surface aeration, and both problems exacerbate the problem of cold winter temperatures, which slow the rate of biodegradation. Surface aeration leads to evaporative cooling of the water, and the shallow depth leads to greater surface area and more water exposed to the cold air above.
- Oxidation ditches are shallow, so for a given aeration volume, they take up much more surface space than deep basins, and space is very limited at the plant.
- The basins are 26 years old and cracked. Ordinarily, one might expect the basins to last 50 years, but conditions at the plant make this unlikely. Sharp seasonal variations in ambient temperature and water temperature cause both concrete and soil to expand and contract, and the cracks already in the basin demonstrate the stress this puts on the structure. The structure may last as little as 40 years, which would give it a remaining life of 14 years.
- Equalization should not be used in the future plant. The secondary clarifiers will be replaced, and they should be designed to accommodate peak flows, thus eliminating the need for equalization. The only conceivable use of the equalization basin is for digestion or aeration. For either, it would be necessary to add additional aeration, since the aerators are not designed for biodegradation. They are designed to reduce odor.
- Diffused aeration should not be added to any of the basins. The shallow depth would yield low diffused aeration efficiency, whereas the shallow depth is conducive to surface aeration. Moreover, no significant investment should be made in retrofitting of the basins, because they are likely to require replacement in a relatively short time. The maximum recommended investment is that required to replace the surface aerators and to fix the basin cracks.
- For continued use as an aerobic digester, the digester aerators would require replacement with floating aerators.

For these reasons, it is not advisable to reuse any of the existing basins, let alone all of them. Rather, equalization should be eliminated, and deep basins with diffused aeration systems should be used for biodegradation and aerobic digestion.

## 3.6 Financial Status of the Ruidoso Wastewater Treatment Plant

The Ruidoso Wastewater Treatment Plant is the central facility that serves both the Village of Ruidoso and the City of Ruidoso Downs. Table 3-4 presents the capital and operating costs of the plant over a four year period.

**TABLE 3-4**

**ANNUAL WASTEWATER TREATMENT PLANT OPERATIONAL EXPENSES**

| Item | Fiscal Period 2000/2001 | Fiscal Period 2001/2002 | Fiscal Period 2002/2003 | Fiscal Period 2003/2004 | 4 Year Average |
|---|---|---|---|---|---|
| Personnel Services | $283,363 | $308,643 | $339,985 | $376,028 | $327,005 |
| Operating | $247,634 | $249,881 | $351,568 | $281,843 | $282,732 |
| Capital Outlay Improvements | $11,339 | $38,085 | $96,691 | $157,740 | $75,964 |
| Total WWTP Expenses | $542,336 | $596,609 | $788,244 | $815,611 | $685,700 |

## 3.7 Financial Status of the Village of Ruidoso Wastewater Collection Facilities

Table 3-5 presents rate schedules for customers with and without municipal water service:

### 3.7.1 Rate Schedules

**TABLE 3-5**

**VILLAGE OF RUIDOSO SEWER SERVICE RATES**

| Metered Service[1] – Minimum Monthly Charge Per Service Unit | | | |
|---|---|---|---|
| Water Meter size (inches) | Residential | Commercial | Institutional or Industrial |
| ¾ | $12.52 | $18.21 | $23.89 |
| 1 | $18.21 | $23.89 | $35.28 |
| 1½ | $23.89 | $29.58 | $52.33 |
| 2 and above | $23.89 | $52.33 | $80.79 |
| Sewer Customers without Municipal Water Service[2] – Minimum Monthly Charge Per Service Unit | | | |
| | Residential | Commercial | Institutional or Industrial |
| Inside Municipal Limits | $15.54 | $21.09 | $32.19 |
| Outside Municipal Limits | $31.08 | $42.19 | $64.39 |

[1] In addition, after the minimum monthly charge, customers are charged $0.75 per 1,000 gallons used in excess of 4,000 gallons, as determined by the water meter reading.
[2] In addition to the minimum monthly charge, sewer customers without municipal water service are charged $0.75 per 1,000 gallons of liquid waste discharged in excess of 4,000 gallons for residential customers.

### 3.7.2 Annual Operating and Maintenance Cost

Table 3-6 presents the Village of Ruidoso sewer collection system operating costs over a four-year period

**TABLE 3-6**

**VILLAGE OF RUIDOSO**

**ANNUAL SEWER COLLECTION SYSTEM OPERATIONAL EXPENSES**

| Item | Fiscal Period 2000/2001 | Fiscal Period 2001/2002 | Fiscal Period 2002/2003 | Fiscal Period 2003/2004 | 4 Year Average |
|---|---|---|---|---|---|
| Personnel Services | $206,928 | $226,113 | $240,979 | $257,307 | $232,832 |
| Operating | $589,500 | $629,924 | $760,263 | $731,664 | $677,838 |
| Capital Outlay Improvements | $353,263 | $13,648 | $100,770 | $11,387 | $119,767 |
| Total System Expenses | $1,149,691 | $869,685 | $1,102,012 | $1,000,358 | $1,030,437 |

### 3.7.3 Number of Connections

Table 3-7 presents the total number of water and sewer connections at the start of a fiscal year.

**TABLE 3-7**

**VILLAGE OF RUIDOSO**

**TOTAL RESIDENTIAL SEWER AND WATER CONNECTIONS**

| Connections | Beginning Fiscal Year 2000/2001 | Beginning Fiscal Year 2001/2002 | Beginning Fiscal Year 2002/2003 | Beginning Fiscal Year 2003/2004 |
|---|---|---|---|---|
| Sewer | 6809 | 6885 | 6947 | 7047 |
| Water | 7930 | 7983 | 8047 | 8149 |
| *Difference* | 1121 | 1098 | 1100 | 1102 |

3.7.4 Tabulation of Users by Monthly Usage Categories

Table 3-8 presents the numbers of residential and commercial users, based on 2004 billing records.

**TABLE 3-8**

**VILLAGE OF RUIDOSO**

**WASTEWATER USERS FOR FISCAL YEAR 2004**

| Source | Users |
|---|---|
| Residential | 6572 |
| Commercial | 511 |
| Total | 7083 |

3.7.5 Revenue Received for the Last Three Fiscal Years

Table 3-9 presents revenue received by the Village of Ruidoso for water and wastewater utilities.

**TABLE 3-9**

**VILLAGE OF RUIDOSO**

**WATER AND WASTEWATER UTILITY REVENUE**

| Revenue | Fiscal Period 2000/2001 | Fiscal Period 2001/2002 | Fiscal Period 2002/2003 | Fiscal Period 2003/2004 | Four-Year Average |
|---|---|---|---|---|---|
| MISCELLANEOUS | $228,317 | $69,357 | $99,091 | $33,733 | $107,625 |
| WATER REVENUES | | | | | |
| Sales | $2,355,438 | $2,436,998 | $2,381,369 | $2,512,847 | $2,421,663 |
| Water Taps | $54,000 | $69,850 | $72,855 | $86,350 | $70,764 |
| Water Misc. | $1,921 | $11,456 | $3,025 | $2,500 | $4,726 |
| Re-connects | $6,380 | $11,170 | $12,790 | $11,675 | $10,504 |
| Water Rights Fund | $2,000 | | $2,640 | $1,328 | $1,989 |
| Turn On | $12,942 | $12,970 | $13,765 | $12,650 | $13,082 |
| Subtotal | $2,432,681 | $2,533,687 | $2,486,444 | $2,627,350 | $2,520,041 |
| SEWER REVENUES | | | | | |
| Sewer Service | $1,015,175 | $1,069,436 | $1,093,248 | $1,105,317 | $1,070,794 |
| Sewer Taps | $7,400 | $10,100 | $8,900 | $12,200 | $9,650 |
| Sewer Hole Tap Fee | $125 | $50 | $125 | $225 | $131 |
| Sewer Misc. | | | | | |
| Sewer Dye Tests | $150 | $550 | $350 | $300 | $338 |
| Subtotal | $1,022,850 | $1,080,136 | $1,102,623 | $1,118,042 | $1,080,913 |
| Total Revenues | $3,683,848 | $3,683180 | $3,688,158 | $3,779,125 | $3,708,578 |

### 3.7.6 Status of Existing Debts

Table 3-10 is a bond debt summary of the Village of Ruidoso's Utility Fund.

**TABLE 3-10**

**VILLAGE OF RUIDOSO UTILITY FUND - BOND DEBT SUMMARY**

| Rate (%) | Issue Maturity Date | Amount Issued | 6/2004 Amount Outstanding | 2004-05 Interest Payments | 2004-05 Principal Payments | Annual Payment Date | Req. Bond Reserve | 6/2005 Amount Outstanding |
|---|---|---|---|---|---|---|---|---|
| 4.76 | 04/01/09 | $1,270,000 | $765,000 | $40,484 | $130,000 | 04/01/05 | $175,000 | $635,000 |

### 3.7.7 Required Reserve Accounts

As shown in Table 3–10, the required bond reserve for the Village of Ruidoso's Utility Fund is $175,000.

## 3.8 Financial Status of the City of Ruidoso Downs Wastewater Collection Facilities

### 3.8.1 Rate Schedules

Table 3-11 presents the minimum rate schedules for customers with and without municipal water service. These rates apply to customers using less than 1000 gallons per month.

**TABLE 3-11**
**CITY OF RUIDOSO DOWNS**
**MINIMUM SEWER SERVICE RATES**

| Metered Service – Minimum Monthly Charge Per Service Unit | | | |
|---|---|---|---|
| Water Meter size (inches) | Residential | Commercial | Institutional or Industrial |
| ¾ | $23.29 | $22.23 | $22.23 |
| 1 | $23.29 | $22.23 | $22.23 |
| 1½ | $23.29 | $22.23 | $22.23 |
| 2 and above | $23.29 | $22.23 | $22.23 |
| Sewer Customers without Municipal Water Service[2] – Minimum Monthly Charge Per Service Unit | | | |
| | Residential | Commercial | Institutional or Industrial |
| Inside Municipal Limits | $15.52 | $43.84 | $43.84 |
| Outside Municipal Limits | $31.04 | $67.14 | $67.14 |

**TABLE 3-16**
**CITY OF RUIDOSO DOWNS**
**WATER AND WASTEWATER UTILITY REVENUE**

| Revenue | Fiscal Period 1999/2000 | Fiscal Period 2000/2001 | Fiscal Period 2001/2002 | Fiscal Period 2002/2003 | Four-Year Average |
|---|---|---|---|---|---|
| JOINT WATER AND SEWER FUND | | | | | |
| Water Revenues | | | | | |
| Water Sales | $273,011 | $256,344 | $295,199 | $369,638 | $298,548 |
| Late Fees | $9,674 | $9,251 | $10,594 | $17,850 | $11,842 |
| Sales Tax | $15,270 | $13,866 | $14,960 | $18,423 | $15,630 |
| Water Taps | $7,975 | $12,113 | $5,475 | $9,625 | $8,797 |
| Re-connects | | $663 | $3,588 | $2,931 | $1,796 |
| Water Misc. | $7,882 | $1,147 | $696 | $1,144 | $2,717 |
| Interest Income | $11,390 | $11,409 | $9,383 | $196 | $8,095 |
| Sale of Surplus | | | $1,851 | | $463 |
| Reserve Revenue | | $12,935 | | | $3,234 |
| Subtotal | $325,202 | $317,724 | $341,743 | $419,804 | $351,118 |

### 3.8.6 Status of Existing Debts

Table 3-17 is a bond debt summary of the City of Ruidoso Downs's Utility Fund.

**TABLE 3-17**
**CITY OF RUIDOSO DOWNS UTILITY FUND - BOND DEBT SUMMARY**

| Rate (%) | Issue Maturity Date | Amount Issued | 6/2004 Amount Outstanding | 2004-05 Interest Payments | 2004-05 Principal Payments | Annual Payment Date | Req. Bond Reserve | 6/2005 Amount Outstanding |
|---|---|---|---|---|---|---|---|---|
| 4.75 | 1998/2038 | $425,000 | $376,000 | N/A | $5,000 | N/A | N/A | $371,000 |
| 5.00 | 1975/2015 | $100,000 | $36,000 | $1,800 | $3,000 | $4,800 | N/A | $33,000 |

### 3.8.7 Required Reserve Accounts

As shown in Table 3–17, the City of Ruidoso Downs's does not have a required bond reserve. The City's bonding capacity is $901,000.

## 3.9 References


1. New Mexico Environment Department (NMED) Standards.
2. Manufacturer's recommendations.
3. Environmental Protection Agency, Nitrogen Control, 1993.
4. Metcalf & Eddy, Wastewater Engineering, 4th Ed., 2003.
5. Texas Commission on Environmental Quality (TCEQ) Standards.
6. Water and Environment Federation, Design of Municipal Wastewater Treatment Plants, 1992.

## 4.0 NEED FOR PROJECT

As described in Section 3, this project is urgently necessary because the existing plant cannot:

- Comply with the current permit,
- Accommodate population growth in the service area,
- Dewater sludge at a sufficient rate, or
- Waste the proper amount of sludge, since the plant would not properly handle the resulting flow of biosolids.

Modification and expansion is urgently needed and should be carried out at Ruidoso's earliest convenience.

### 4.1 Health and Safety

The standards for effluent quality and residuals processing are based partly on concern for public health. The plant cannot meet the effluent standard that currently applies, so regulatory agencies and the public may perceive a danger to public health posed by the plant. Section 4.1.1 addresses in more detail concerns over plant effluent quality.

The system of sludge digestion and air drying cannot handle the amount of sludge generated. Hence, plant's ability to produce Class A or Class B sludge is compromised, and the public may perceive a health hazard due to the pathogen level and vector attraction of the sludge.

The plant may be considered hazardous to its workers for a number of reasons, including trip hazards, noise pollutants, proximity to electrical equipment, and the use of dangerous gasses for disinfection. Section 4.1.2 addresses safety concerns in more detail.

#### 4.1.1 Effluent Quality

Between 1998 and 2000, the New Mexico Water Quality Control Commission (WQCC) reviewed its standards for surface waters. In 2000, the Commission established a phosphorus limit of 0.1 mg/L for Segment 208 of the Rio Ruidoso, which receives the plant effluent. The Commission established several other standards, based in part on the needs of users who draw from the Segment. Table 3-1 describes the boundaries of Segment 208, the water quality standards, and a list of the current uses.

In November of 2000, EPA issued NPDES Permit No. NM0029165, with a compliance deadline of January 2004. Table 4-2 summarizes the permit, which applies to the plant effluent. The plant cannot comply with that permit at current flows, and certainly not at future flows. For example, the concentration of phosphorus in the effluent is roughly 2.4 mg/l, compared to 0.1 mg/l in the effluent permit and the stream standard. The WET test is not being performed, as required by the permit, and the effluent would likely fail the test if it were performed.

**TABLE 4-1**

**RUIDOSO WASTEWATER TREATMENT PLANT – NPDES PERMIT LIMITS (JANUARY 1, 2001 – AUGUST 31, 2007)**

| Effluent Characteristics | Discharge Limitations | | | |
|---|---|---|---|---|
| | kg/day (lbs/day) 30-day Average | Other Units (Specify) | | |
| | | 30-day Average | 7-day Average | Daily Maximum |
| Flow | N/A | Report (mgd) | N/A | Report (mgd) |
| Biochemical Oxygen Demand (5-day) | 295 (650) | 30 mg/l | 45 mg/l | N/A |
| Total Suspended Solids | 295 (650) | 30 mg/l | 45 mg/l | N/A |
| Fecal Coliform Bacteria (Colonies/100 mL) | N/A | 500 | 500 | |
| Cyanide (Weak acid dissociable) | 0.06 (0.13) | 6.07 μg/l | N/A | 9.1 μg/l |
| Mercury (Total) | 0.00021 (0.00046) | 0.021 μg/l | N/A | 0.014 μg/l |
| Phosphorus | 1 (2.2) | 0.1 mg/l | N/A | 0.15 mg/l |
| Vanadium (Total) | Report | Report (μg/l) | N/A | Report (μg/l) |
| Whole Effluent Toxicity | 7-Day Chronic NOEC Freshwater | | | |
| Species | Ceriodaphnia dubia, Pimephales promelas | | | |
| Critical Dilution | 57% | | | |
| No detectable chlorine in effluent. | | | | |
| pH between 6 and 9, measured with same frequency as TSS. | | | | |
| No discharge of floating solids or visible foam in other than trace amounts. | | | | |

Although the plant currently meets the listed requirements on $BOD_5$ and TSS, the plant is already overloaded, and some of the equipment is either damaged or nonfunctional. A modest increase in loading to the plant may cause the plant to exceed permit limits on $BOD_5$ and TSS. Because the average project takes five to seven years to plan, design, and build, such an increase in plant loading is likely to occur before a plant expansion can be built. It is therefore imperative that Ruidoso begin work on the plant expansion as soon as possible.

The permit requires that the Whole Effluent Toxicity (WET) of the plant effluent be measured. This is not being done, but the effluent would most likely fail the test if it were done. Passing the WET test will most likely require biological nitrification.

The permit limits the plant discharge to 0.1 mg/1 phosphorus, and compliance with this limit will require heavy chemical treatment of the plant throughput. During the preparation of this PER, Ruidoso investigated the possibility of an increase in the effluent phosphorus limit to 1.0 mg/l utilizing a "Water Quality Trading Program" to reduce or eliminate non-point source discharges of phosphorus to the Rio Ruidoso in exchange for the increased effluent limit. A consultant was retained to investigate the potential of the proposed Water Quality Trading Program, and it was concluded that such a program lacked the necessary trading potential on this segment of the Rio Ruidoso. As such, the 0.1 mg/l effluent phosphorus limit is in effect and compliance with this limit will be required. Consequently, despite occasional references to a 1.0 mg/l effluent phosphorus limit, this PER should be understood as reflecting Ruidoso's commitment to construct and operate a plant capable of meeting the required 0.1 mg/l effluent phosphorus limit.

Since the 1.0 mg/l phosphorus effluent limit was being studied during the preparation of this PER, the PER has been prepared to address both a 1.0 mg/l and 0.1 mg/l phosphorus limit. This PER presents a plan for installation of a biological treatment process capable of reducing plant effluent phosphorus to 1.0 mg/l. The PER further presents a tertiary chemical process that is installed downstream of the activated sludge process to achieve the required phosphorus limit of 0.1 mg/l.

To ensure current and future compliance with the permit, Ruidoso proposes to:

- Encourage the public to curtail their use of phosphorus-rich detergents and cleaners, thereby reducing the amount of phosphorus entering the plant.
- Expand the plant as necessary to accommodate future flows, which are projected in Section 4.3.
- Fit the expanded plant with a biological phosphorus removal system designed for an effluent standard of 1 mg/1.
- Install an independent, tertiary chemical process downstream of the activated sludge process. This chemical phosphorus removal system will treat the entire plant throughput, reducing effluent phosphorus to 0.1 mg/l or less.
- Design the plant for biological nitrification and dentrification.

Plant modifications are the focus of this PER, which does not examine the proposals to reduce public phosphorus use and to eliminate non-point sources.

### 4.1.2 Plant Safety

The following safety hazards further underscore the urgent need to implement the proposed project, which would fix the problems as follows:

- The positive-displacement blower for the aerated grit chamber is not muffled. The Occupational Safety and Health Administration (OSHA) requires that a noise pollutant be muffled to a sound power no greater than 85 dba at a distance of 3 feet from the unit. The sound power should be measured at three feet from the blower. If it is greater than 85 dba, which it most likely is, the blower should be muffled.
- In the O&M Building, a conference table has been placed next to the motor control centers. This table should be moved from the room, because it is not ideal for workers to sit for extended periods next to the motor control centers.
- Some of the sidewalks around the secondary clarifiers and aeration basins are cracked or misshapen, causing a trip hazard. The sidewalks around the clarifiers should be repaired.

The sidewalks around the aeration basins should be kept if the aeration/equalization structure is kept.

- The plant currently uses chlorine and sulfur dioxide gasses to disinfect the effluent, and these are dangerous gasses. The goal of disinfection without residual can be met more safely with ultraviolet disinfection, which is considered further in Section 5.

## 4.2 System Operation and Maintenance (O&M)

In general, the plant cannot comply with the current permit, tolerate near-term growth, or reliably treat its residual biosolids to the standards required for surface disposal. No change in operating procedure can fix this problem, and the problem isn't due to a lack of maintenance, so O&M concerns do not necessitate the project, although they affect the project as described in Section 5. An increase in plant capacity is necessary, but before arriving at this conclusion, the following issues were addressed.

### 4.2.1 Infiltration and Inflow

The Wastewater Facilities Plan of 1993 showed that the plant was receiving roughly 0.9 mgd of groundwater infiltration. The Plan further estimated that direct manhole inflow during storm events could be as much as 1.0 mgd.

Since the 1993 Plan, Ruidoso has greatly reduced infiltration to its sewer collection system, and efforts to reduce it further are ongoing. In support of this effort, Ruidoso has purchased a number of television cameras for visual inspection of sewer lines, and they have commissioned a study of the five-mile Joint Use Interceptor, which crosses Ruidoso Downs and empties into the WWTP. This study, performed by Molzen-Corbin, provides a rough estimate of the rate of infiltration loaded to the plant. Using methods intended to provide a rough approximation of infiltration, the study suggests an infiltration rate of roughly 0.25 mgd.

The 1993 Plan estimated that storm events caused an inflow rate approaching 1.0 mgd, and the Plan suggested that inflow entered the system directly through manhole covers. The Plan concluded that the installation of inflow protectors on the manhole covers caused a pronounced reduction in the rate of inflow, and continued installation of inflow protectors was recommended.

### 4.2.2 Inefficient Designs

The efficiency of the original plant design has no bearing on the need for capacity increase. The existing plant cannot be made efficient enough to comply with the existing permit and accommodate area population growth.

### 4.2.3 Managerial Problems

Ruidoso has only one facility for treating wastewater, and that is the plant. No change in wastewater management can substitute for a plant capacity increase, other than the building of a second plant, which itself is a capacity increase. A second plant is not recommended. The capacity of the existing plant must be increased.

## 4.3 Growth

### 4.3.1 Per Capita Wastewater Flow Contributions

Ruidoso's population varies widely, due to its heavy tourist load, so it is difficult to correlate wastewater flow with population. A conservative correlation is made using data from Census 2000, which shows that in Ruidoso Village and Ruidoso Downs, seasonal housing accounted for 48.8 percent and 16.9 percent of total housing, respectively.

The per capita flow is the flow per permanent resident served by the plant. To estimate the per capita flow, the flow rate of wastewater to the plant is divided by the permanent population served by the plant, thereby obtaining the flow per capita. The challenge in estimating flow per capita is in determining what flow record and what population to use for the calculation.

In the typical case, the per capita flow accounts for commercial and residential wastewater flows. In Ruidoso's case, the per capita flow also accounts for flow generated by part-time residents, but the number of permanent residents is used for the calculation. Hence, the per capita flow estimate is higher for Ruidoso than for most cities.

Table 4-2 calculates the per capita flow for each month of the year 2000 based both on monthly average flow and peak daily flow. Plant effluent flows are used due to the inaccurate measurement of plant influent flow. Census 2000 measured a permanent Ruidoso population of 9,522, and this population is used for each per capita flow estimate.

**TABLE 4-2**

**UNIT FLOWS FOR YEAR 2000**

| Month | Effluent Monthly Avg. Flow, mgd | Effluent Peak-Day Flow, mgd | Per Capita Flow Based on Avg-Day Flow, gpd | Per Capita Flow Based on Peak-Day Flow, gpd |
|---|---|---|---|---|
| January | 1.30 | 1.83 | 137 | 192 |
| February | 1.24 | 1.49 | **130** | 156 |
| March | 1.29 | 1.50 | 135 | 158 |
| April | 1.27 | 1.45 | 133 | 152 |
| May | 1.29 | 1.59 | 135 | 167 |
| June | 1.44 | 1.84 | 151 | 193 |
| July | 1.66 | 1.84 | **174** | 193 |
| August | 1.46 | 1.63 | 153 | 171 |
| September | 1.27 | 2.01 | 133 | 211 |
| October | 1.27 | 1.41 | 133 | 148 |
| November | 1.33 | 1.57 | 140 | 165 |
| December | 1.33 | 1.57 | 140 | 165 |
| Average for 2000 | 1.35 | 1.64 | 141 | 173 |
| Maximum Month | 1.66 | 2.01 | **174** | 211 |

The maximum monthly average flow occurred in July, yielding a unit flow of 174 gpd, which is considered a conservative estimate of flow per capita. This flow is therefore used to project future flows based on future increases in the permanent population. A 2-hour peaking factor of 2.6 is used, because this is the maximum peaking factor reported by Ruidoso.

Per capita flows based on peak daily flows are provided only for reference. In preliminary design, they may be used for hydraulic calculations.

The average unit flow for February was 130 gpd, which is herein referred to as the winter unit flow. This should not be used to design the future plant, but it is useful in gauging the potential longevity of the future plant, and in determining whether the future capacity expansion will be phased. Future winter wastewater flows are also projected using the winter unit flow of 130 gpd. A 2-hour peaking factor of 2.0 is assumed for winter flows, because this is the maximum winter peaking factor reported by Ruidoso.

In summary, an equivalent flow per capita, referred to as the unit flow, of 174 gpd is used to project future flows, which are used to design a plant expansion. A winter unit flow of 130 gpd is used to predict future winter flows, but future winter flows are not used for design. They are used to make additional recommendations on the plant expansion.

#### 4.3.2 Population Growth Forecast

Section 2.3 uses multiple methods to predict the future population growth of Ruidoso. The findings are summarized in Figure 2-3. In Section 2.3, it was concluded that the most likely rate of population growth was 2.82 percent. Assuming that the Ruidoso population was 9,522 in the year 2000, as measured by Census 2000, the population predicted for the year 2030 is 21,930.

#### 4.3.3 Water Rights

Ruidoso's water rights are evaluated to determine whether Ruidoso has enough potable water available to produce the projected wastewater flows.

Ruidoso draws groundwater and surface water from the Eagle Creek Basin and the Rio Ruidoso, respectively. From the Eagle Creek Basin, Ruidoso has permanent rights to 6,546.49 acre-feet per year and temporary rights (until 2009) to 600 acre-feet per year. From the river, Ruidoso has permanent rights to 306.16 acre-feet per year and temporary rights (until 2020) to 180.09 acre-feet per year. Depending on flow conditions in the river, Ruidoso may obtain an effluent credit approaching 800 acre-feet per year. Table 4-3 summarizes the status of Ruidoso's water rights.

**TABLE 4-3**

**RUIDOSO AVAILABLE WATER RIGHTS**

| Basin | Water Rights (acre-ft/yr) | | | |
|---|---|---|---|---|
| | Existing | Leased | Return-Flow Credit | Total Available |
| Eagle Creek | 6,546.49 | 600 | - | 7,146.49 |
| Rio Ruidoso | 306.16 | 180.09 | 800 | 1,286.25 |
| Total | 6,852.65 | 780.09 | 800 | 8,432.74 |

Ruidoso's permanent water rights total 6,852.65 acre-feet per year, or 6.1 mgd. If temporary water rights and the return flow credit are included, Ruidoso's water rights total 8,432.74 acre-feet per year, or 7.5 mgd.

### 4.3.4 Wastewater Design Flows

The population growth rate estimated in Section 2.3 is assumed to start in 2000, when the last Census was taken. This 2.82-percent annual growth rate is used to estimate the permanent population for following years. The population calculated for each year is multiplied by the unit flow (174 gpd) calculated in Section 4.3.1, yielding a projected average daily flow for that year. Table 4-4 shows the projected wastewater flows through the end of the project planning period, which runs from 2005 to 2030.

**TABLE 4-4**

**RUIDOSO WASTEWATER TREATMENT PLANT PROJECTED FLOWS**

| Year | City of Ruidoso Downs Projected Population | Village of Ruidoso Projected Population | Total Projected Population Served | Wastewater Plant Design Flow (mgd) | Wastewater Winter Flow (mgd) |
|---|---|---|---|---|---|
| 2000[1] | 1824 | 7698 | 9522 | 1.66 | 1.24 |
| 2001 | 1875 | 7915 | 9790 | 1.70 | 1.27 |
| 2002 | 1928 | 8138 | 10066 | 1.75 | 1.31 |
| 2003 | 1983 | 8368 | 10351 | 1.80 | 1.35 |
| 2004 | 2039 | 8604 | 10643 | 1.85 | 1.38 |
| 2005 | 2096 | 8846 | 10942 | 1.90 | 1.42 |
| 2006 | 2155 | 9096 | 11251 | 1.96 | 1.46 |
| 2007 | 2216 | 9352 | 11568 | 2.01 | 1.5 |
| 2008 | 2278 | 9616 | 11894 | 2.07 | 1.55 |
| 2009 | 2342 | 9887 | 12229 | 2.13 | 1.59 |
| 2010 | 2409 | 10166 | 12575 | 2.19 | 1.63 |
| 2015 | 2768 | 11683 | 14451 | 2.52 | 1.88 |
| 2020 | 3181 | 13425 | 16606 | 2.89 | 2.16 |
| 2025 | 3656 | 15428 | 19084 | 3.32 | 2.48 |
| 2030 | 4201 | 17730 | 21931 | 3.82 | 2.85 |

### 4.3.5 Suggested WWTP Expansion

The 1993 Wastewater Facilities Plan estimated an existing plant capacity of 1.9 mgd, which is close to the flow estimate of Table 4-5 for the year 2005. Since the plan was written, no capacity has been added to the plant. Based on the permit currently in place, Section 3 estimates that the capacity of the existing plant is roughly 0.68 mgd.

Table 4-4 shows the flows predicted for the 25-year planning period. By the end of that planning period, summer flow is projected to increase to 3.8 mgd. Winter flow is expected to increase to 2.85 mgd. Since it is not certain that the Ruidoso population will continue to fluctuate throughout the year, it must be assumed that, in the worst case, winter flow will also be 3.8 mgd, and the future plant should be designed to treat 3.8 mgd at the lowest winter wastewater temperature, which is roughly 50 °F. It should be noted that the current plant rating of 0.77 mgd is also based on this temperature.

The plant should be expanded from its current rated capacity of 0.68 mgd to 3.8 mgd over the next 25 years. This is an increase by nearly a factor of 6. It would be imprudent to carry out such a large expansion in one project, especially since it is not certain that a capacity of 3.8 will ever be needed. The number is based on winter flow, and Table 4-4 shows clearly that winter flows may never approach 3.8 mgd, and a plant designed for the lesser winter flow of 2.9 mgd would accommodate 3.8 mgd during the summer months, since biological treatment rates increase in warm weather. Hence, a plant designed for 3.8 mgd may be oversized for the next 25 years.

### 4.3.6 Recommendation of Phased Expansion

A more prudent approach would be to expand the plant in two phases. Phase I would increase the plant winter capacity to 2.5 mgd, using parallel treatment processes each rated for 1.25 mgd. This would last at least through 2015 and possibly for a longer period. When the plant nears full capacity, another 1.25-mgd process could be added in parallel to the first two, bringing the capacity to 3.75 mgd. This is near the flow projected for the end of the planning period, and it is considered sufficient for the planning period.

## 4.4 References

1. Metcalf & Eddy, Wastewater Engineering, 4th Ed., 2003.

## 5.0 ALTERNATIVES CONSIDERED

This section presents the alternatives considered for management of Ruidoso wastewater flows throughout the planning period, which runs from 2005 to 2030. The alternatives refer to management of wastewater flows entering the present and future collection systems managed by the Joint Use Board, and not to non-point waste sources within the planning area. As such, the alternatives discussed are alternatives for treatment of the collected wastewater.

In general, the alternatives herein would enable Ruidoso to comply with state and federal wastewater regulations and to accommodate population growth within the planning area, which will increase wastewater flows as projected in Section 4.

Modification of Ruidoso's sewage collection system is not considered, as the collection system is considered adequate. On-site treatment systems for individual wastewater generators are not considered. All alternatives involve modification of the existing Ruidoso Wastewater Treatment Plant (WWTP).

### 5.1 Evaluation Criteria

The criteria used to screen the alternatives are presented herein. Alternatives are first screened, and only those deemed feasible are examined in detail. The alternatives are compared and ranked according to the following criteria.

#### 5.1.1 Regulatory Compliance

The plant must maintain compliance with applicable state and federal regulations, regardless of variations in ambient conditions, hydraulic loading, and organic loading. The regulations apply mainly to the plant effluent quality and the disposal of residual biosolids.

All alternatives account for loading variations, but they still differ in their reliability. For instance, an alternative that uses deep basins with diffused aeration is preferred over one that uses shallow basins and surface aeration, since shallow basins expose more water surface to cold weather, and surface aeration causes evaporative cooling of the wastewater, which further exacerbates the problem of cold winter temperatures.

The primary concern with regulatory compliance is the ability of the plant to comply with the phosphorus effluent discharge permit. All feasible alternatives recommend the installation of an anaerobic selector for biological phosphorus removal. An anaerobic selector is typically a serpentine basin placed between the headworks and the aeration basins. The return activated sludge (RAS) is pumped to this basin, where it is contacted with influent from the headworks. The bacteria in the RAS quickly consume nitrates and dissolved oxygen, leaving an anaerobic environment that causes absorption of phosphorus into the bacteria, which are called biomass. This phosphorus absorption is called *luxury uptake*. This system will remove a significant portion of the phosphorus applied to the plant, but biological treatment alone may not be sufficient to meet the stringent phosphorus standards set for the plant effluent, and supplemental chemical treatment is considered.

Chemical phosphorus removal is generally accomplished with the use of a coagulant, such as alum, ferric chloride, or lime. In a typical process, coagulant is mixed vigorously with phosphorus-rich water in a step called rapid mix, where coagulant molecules react with phosphorus to form compounds such as aluminum phosphate. These compounds tend to come out of solution and form suspended particles. The next step, called flocculation, stirs the water gently, causing the suspended particles to collide and bond, creating larger particles that are called floc. In the third step, called sedimentation, the water flows to a settling basin where the large floc particles settle to the bottom and are collected with sludge scrapers, as with primary or secondary sludge settling. Alternately, the floc may be removed from the water by filtration. In a wastewater plant, the resulting chemical sludge is typically mixed with the biological sludge, and the amount of chemical sludge is generally far less than the amount of biological sludge.

To avoid overloading biological phosphorus removal processes, some wastewater plants use chemical treatment on plant return flows, such as digester decant, belt press filtrate, and plant drains. Treatment systems for plant returns are generally small, since plant return flows are generally small. Some wastewater plants apply chemical treatment to the entire plant throughput. The modules required for this are costly, as are the ongoing costs of chemical purchase and sludge disposal.

All feasible alternatives recommend the same approach to phosphorus removal. This approach is summarized here and described in Section 5.4.

Each feasible alternative starts with a biological phosphorus removal system, which includes chemical treatment of plant return flows. The biological system can reduce effluent phosphorus to 1 mg/l.

Each feasible alternative recommends an independent, tertiary chemical treatment process downstream of the activated sludge process. This chemical phosphorus removal system will treat the entire plant throughput, reducing effluent phosphorus to 0.1 mg/l or less. Return flows will be routed to the head of the chemical system, and not to the head of the plant.

The ranked alternatives differ in how their activated sludge processes may enhance the proposed biological and chemical phosphorus removal systems.

### 5.1.2 Expandability

The WWTP is to be expanded in two phases, as recommended in Section 4. Phase I expands the plant capacity to 2.5 mgd, and Phase II expands the capacity to 3.75 mgd. This report presents alternatives for expansion of the plant to Phase I flow (2.5 mgd), with the understanding that an expansion to Phase II flow (3.75 mgd) may become necessary in the future. The alternatives are ranked in terms of how easily they can be expanded to Phase II flow.

### 5.1.3 Site Efficiency and Constructability

The site efficiency and constructability of an alternative are of paramount importance given the small amount of plant space available for the building of new, large treatment modules.

Ideally, Ruidoso should be able to acquire additional land for expanding the WWTP, but it is not certain that this can be done. If new land cannot be acquired, the construction may have to be staged, as explained in Sections 3.5.1 and 3.5.2.

Alternatives that use fewer and/or smaller treatment components are considered more site-efficient because they require less space, and more constructible because they can be built more quickly.

### 5.1.4 Operation and Maintenance

Plant operation should not be unduly complicated or difficult, and the components should not require frequent repair or adjustment. A more complex plant will be necessary to comply with the current permit, and this complexity cannot be avoided, but the plant should not be so complex that it cannot be sustained by a New Mexico Class 4 Operator.

### 5.1.5 Public Acceptance

The expanded plant should not produce excessive odor. The public should accept the plant technology as safe, reliable, and environmentally friendly.

### 5.1.6 Cost Considerations

The design should minimize the capital and operating costs, which are combined into a present worth of cost.

## 5.2 Initial Screening of Alternatives

This section lists the alternatives initially screened according the criteria of Section 5.1. Table 5-1 lists these alternatives.

**TABLE 5-1**

**ALTERNATIVES INITIALLY SCREENED**

| Alternative | Description |
|---|---|
| 1 | Conventional Biological Nutrient Removal (BNR) |
| 2 | Simultaneous Nitrification and Denitrification |
| 3 | Membrane Bioreactors (MBR) |
| 4 | No Action |
| 5 | Zero Discharge |
| 6 | Alternate Discharge |
| 7 | Sequencing Batch Reactors |

### 5.2.1 Alternative 1: Conventional Biological Nutrient Removal (BNR)

Alternative 1 recommends replacement of the existing activated sludge process with a new BNR process.

Alternative 1 follows the headworks with an anaerobic selector that contacts the return-activated-sludge (RAS) with headworks effluent, for the purpose of phosphorus removal.

After the anaerobic selector, flow splits equally into two parallel activated sludge basins. For Phase II, a third basin will be added. Each basin is divided into two zones. The first zone is anoxic, or depleted of oxygen but rich in nitrate. This zone is mixed but not aerated. In this zone, aerobic bacteria, called biomass, strip oxygen from the nitrate and use it to consume organics, which herein are referred to as biochemical oxygen demand (BOD). The remaining nitrogen gas is released into the air. This process is called *denitrification*.

Wastewater flows from the anoxic zone into the aerobic zone, in which BOD reduction takes place. In a process called *ammonification*, the biomass converts organic nitrogen into ammonia.

In a subsequent process called *nitrification*, the biomass uses dissolved oxygen (DO) to convert ammonia into nitrate. Airlift pumps recycle mixed liquor from the aerobic zone into the anoxic zone, at a rate of roughly four times the plant throughput. The aerobic zone thereby supplies the anoxic zone with the nitrates left from nitrification.

Typically, denitrification is used less for the breakdown of BOD and more for the removal of nitrate. The denitrification step is not necessary for compliance with the current permit, since the permit contains no specific nitrogen limitation, and nitrates are not toxic to the animals specified for the WET test. However, denitrification is still recommended for the following reasons:

- Denitrification uses nitrate nitrogen in lieu of oxygen for the breakdown of BOD. Hence, in the pre-anoxic zone used for denitrification, it is not necessary to aerate, and money is saved on the electricity that would be required for aeration. Mechanical mixing is required in the pre-anoxic zone, but this uses far less electricity than aeration.
- In an aerobic or anoxic basin, the bacteria bond together into suspended particles called *floc* particles. In an anoxic zone, the nitrate is often consumed before it can reach the interiors of the floc particles, so small anaerobic zones form within the floc particles. These leads to more luxury uptake of phosphorus in the pre-anoxic zone.
- Nitrification consumes alkalinity, which may make it necessary to add caustic or lime to the plant influent. However, denitrification reclaims roughly half of the alkalinity consumed during nitrification, and this may make it unnecessary to add alkalinity to the plant influent.
- Future permit revisions may limit the amount of total nitrogen in the plant effluent, possibly due to concern over algae in receiving waters. Total nitrogen permits typically make denitrification necessary. Since the plant is being designed for the next 25 years, and since such a permit revision may occur within the next 25 years, it is prudent that the treatment basins be sized and equipped for denitrification.
- Treatment basins sized for denitrification are up to a third larger than typical aerobic basins, and the basins are often equipped with aeration equipment. This leads to greater operational flexibility. On a day of unusually cold temperature, high flow, or high-strength influent, the anoxic zone can be aerated if necessary to accomplish the required BOD reduction.

The water contained in the treatment basins is called the mixed liquor. The mixed liquor flows from the treatment basins and splits equally into two clarifiers. A third clarifier will be added for Phase II. The clarifiers concentrate the biomass and return it to the anaerobic selector. Treated water flows over the clarifier weirs. The treated water flows to the chemical phosphorus removal process to reduce effluent phosphorus to 0.1 mg/l.

This steady-flow process is most typically used at plants that are required to remove nitrogen and phosphorus from wastewater. The operation is similar to an ordinary complete-mix, activated-sludge process, and operation is not unduly complicated. The equipment required for the process are typical of that found in most wastewater plants, and no excessive or unusual maintenance is required. For these reasons, Alternative 1 is reserved for further consideration.

### 5.2.2 Alternative 2: Simultaneous Nitrification and Denitrification

Alternative 2 recommends replacement of the existing activated sludge process with a simultaneous nitrification-denitrification (SNdN) process. SNdN uses precise control of dissolved oxygen in the aeration basin, causing BOD metabolism, ammonification, nitrification and denitrification to occur in the same basin. This eliminates the need for a separate anoxic basin and the accompanying internal recycle pumps.

In an aeration basin, if the dissolved oxygen (DO) concentration is maintained at a sufficiently low level, normally around 0.5 mg/l, the bacteria in the outer portion of a typical floc particle take up all DO that contacts the particle. This creates an anoxic zone in the particle interior, and the bacteria therein must use nitrate oxygen to metabolize BOD, causing the evolution of nitrogen gas from the water. In some cases, an anaerobic zone forms deeper within a typical particle, leading to luxury uptake of phosphorus.

The SNdN process is achieved with probes that sit in the mixed liquor and use ultraviolet light to measure the concentration of a protein byproduct of BOD metabolism. Indirectly, the probes measure the concentration of dissolved oxygen. The SNdN process can be accomplished only with the probes, because other available methods of measuring DO concentration take too long to detect changes in DO concentration.

The probes send readings to the variable-frequency drives (VFD) on the blowers supplying the aeration basin. In an optimization of the process, the operator determines the optimal concentration of DO in the basin, and he or she instructs the control system to maintain that DO concentration, which is called the setpoint. If the DO concentration drops below the setpoint, the probes send a signal to increase the blower speeds, raising the DO concentration back to the setpoint. If the DO concentration goes above the setpoint, the probes send a signal to reduce the blower speeds, thereby lowering the DO concentration back to the setpoint.

The probes do not require sample pumps, and the probes require little maintenance. In a typical case, the operator would remove a probe, wipe the ultraviolet lens with a paper towel or newspaper, and put the probe back in place.

Alternative 2 follows the headworks with an anaerobic selector that contacts the RAS with headworks effluent, for phosphorus removal. After the anaerobic selector, flow splits equally into two parallel SNdN basins. Toward the back of each basin, the mixed liquor flows into a post-aeration zone, which raises the DO concentration to prevent denitrification from occurring in the clarifiers.

Flow is split equally into two clarifiers, and a third clarifier will be added for Phase II. The clarifiers concentrate the biomass and return it to the anaerobic selector. Treated water flows over the clarifier weirs. The treated water flows to the chemical phosphorus removal process to reduce effluent phosphorus to 0.1 mg/l.

Though relatively new, the SNdN process has proven itself at multiple installations throughout the United States and Europe, and it has several important advantages over a conventional BNR process.

- The process can remove some phosphorus in the aeration basins. This alone warrants further consideration of SNdN, because the effluent permit has such a stringent phosphorus limitation.
- The process maintains a DO concentration that is roughly a fourth of that found in a typical aeration basin, and the lesser rate of aeration results in significant power savings. One manufacturer claims a power savings of up to 33 percent over a conventional BNR process.
- Additional energy savings stem from the absence of an internal recycle, which is generally about four times the design plant throughput.
- The low dissolved oxygen level reduces the growth of filamentous bacteria, leading to more efficient settling and allowing a higher mixed liquor suspended solids (MLSS) concentration.
- The process requires significantly less basin volume than a conventional BNR process, leading to a reduction in the capital cost of concrete, and utilizing plant space more efficiently.

For these reasons, Alternative 2 is reserved for further consideration.

### 5.2.3 Alternative 3: Membrane Bioreactors (MBR)

Alternative 3 recommends replacement of the existing activated sludge process with a biodegradation process utilizing membrane bioreactors (MBR).

MBRs are membranes that are packed together in units called cassettes, which sit immersed in an aeration basin. The cassettes are normally positioned in rows, with two to a row, and several rows in a basin, and the cassettes may also be stacked vertically, with a maximum of two cassettes per stack. Coarse-bubble diffusers are positioned directly beneath the membrane surfaces so that the bubbles contact the membranes before reaching the water surface. A film forms on the surface of a typical membrane, and the coarse bubbles shear biomass from the membrane surface, thus maintaining a constant film thickness. The coarse bubble aerators allow suspended-growth biodegradation to occur in the mixed liquor surrounding the cassettes.

The coarse-bubble aeration rate applied to the cassettes is set according the requirements of the cassettes, and not according to the amount of BOD and ammonia to be reduced. Thus, not all necessary reaction can take place in the cassette basin, and a pre-aeration basin or zone must precede the cassette basin.

A cassette comes equipped with pumps that draw water through the membranes and pump it to the top of the basin. From this point, the treated water, or permeate, can drain directly to disinfection. The membranes eliminate the need for clarifiers or filters, and the permeate is far cleaner than most wastewater effluents, even those with tertiary treatment.

RAS and WAS are generally drawn from the cassette basin. The MLSS in this basin is generally about 8,000 mg/l, which is similar to most clarifier underflows, so it is not necessary to pump excessive amounts of RAS or WAS.

Alternative 3 splits the headworks effluent evenly into two parallel basins, each containing an anaerobic selector, anoxic zone, pre-aeration zone, and cassette zone. Flow to a basin first enters the anaerobic selector, where it contacts RAS drawn from the cassette basin. Flow then enters the anoxic zone, and after the required anoxic residence time, the flow is pumped to the pre-aeration zone, which is at the opposite end of the basin. The aerated water then flows back toward the front of the basin and into the cassette zone. Mixed liquor from the cassette zone then flows over a weir and into the anoxic zone, and this weir overflow serves as the internal anoxic recycle necessary for denitrification.

RAS and WAS pumps draw water from the cassette zone and pump it either to the anaerobic selector or to sludge processing. The permeate pumps of each cassette draw water through the membranes and into a common clearwell. The treated water flows to the chemical phosphorus removal process to reduce effluent phosphorus to 0.1 mg/l.

The MBR process has several important advantages over a conventional BNR process.

- If the effluent phosphorus limit remains at 0.1 mg/l, an MBR system facilitates the installation and operation of the tertiary chemical treatment system proposed herein. The small footprint of the MBR system leaves more room for the basins, clarifiers and/or filters necessary for a chemical removal system. The effluent from an MBR-based activated sludge process is much cleaner than a typical secondary effluent, which may reduce the coagulant dose required for the tertiary process. Additionally, the MBR system leaves more hydraulic head available for use by the tertiary process.
- MBRs may facilitate the addition of chemical phosphorus removal to the activated sludge process itself, thereby avoiding the need for a tertiary process.
- Although MBRs are expensive, because the technology is new, the price may go down before preliminary design is started.

For these reasons, Alternative 3 is reserved for further consideration.

### 5.2.4 Alternative 4: No Action

Alternative 4 is the no-action approach. For reasons described in Sections 3 and 4, this is not recommended. Action must be taken because the existing plant cannot comply with the current discharge permit at current flows, and it certainly cannot accommodate future flows.

Alternative 4 is not considered further.

### 5.2.5 Alternative 5: Zero Discharge

Alternative 5 would eliminate the plant effluent discharge to the Rio Ruidoso, thereby avoiding the federal regulations on discharges to the river. The principle ways to accomplish this are as follows.

Use of Effluent for Irrigation

Although the use of effluent for irrigation would eliminate the phosphorus requirement for discharge to the Rio Ruidoso, it may still require nitrification and denitrification. The New Mexico Water Quality Control Commission (WQCC) limits the amount of nitrogen that can be land applied, specifying that the land application of wastewater effluent may not raise the nitrate concentration in the underlying groundwater to above 10 mg/l. WQCC requires the installation of monitoring wells to verify compliance with this standard, unless the total nitrogen concentration in the WWTP effluent is less than 10 mg/l.

To be used for irrigation, the wastewater effluent would have to meet NMED reuse standards, which may require filtration of the plant effluent, depending on the area to which the water is applied.

Irrigation Land Requirement

To guarantee conformance with the WQCC groundwater standard, the rate of land application is normally limited to that which applies 200 pounds of nitrogen per acre per year (lb/acre/yr). This figure does not account for plant uptake of nitrogen. If uptake by vegetation is used to justify an increase in the watering rate, harvest and replanting of the vegetation may be required. Monitoring wells may be required to verify that the vegetation is consuming enough nitrogen.

To minimize the amount of land required, and to eliminate the necessity of monitoring wells, land-applied wastewater is often treated to a standard of 10 mg/l total nitrogen (TN). Assuming that the WWTP treats effluent to less than 10 mg/l TN, and applying the standard of 200 lb/acre/yr, it is calculated that 88 inches per year of effluent may be land-applied. For Phase I flow, this requires 381 acres. For Phase II, this requires 572 acres.

If a greater amount of land is available, the need for nitrogen removal at the WWTP may be reduced or eliminated entirely. This would greatly reduce the cost of plant expansion. Conservatively assuming that the plant influent carries 50 mg/l total nitrogen, and that none is removed at the plant, an effluent land application rate of 18 in/yr may be possible. This most likely would not satisfy the vegetation in the area, so supplemental irrigation with potable or well water would be required. Phase I flow would require 1900 acres. Phase II flow would require 2,850 acres.

Irrigation Water Storage Requirements

In the cold climate of Ruidoso, it is uncertain whether continuous land application of effluent would be possible. Cold weather, rain, or snow may reduce the permeability of the soil or saturate the soil, leading to runoff the land-applied wastewater into nearby surface waters, which is not allowed. It may be possible to mitigate the runoff by surrounding the irrigation area with a dike, so that wastewater effluent would remain in the irrigation area, ultimately percolating into the soil or evaporating. The area vegetation may also provide some transpiration, in which water is taken up by plants and evaporated from the plant surfaces. The irrigation equipment may also help in reducing runoff. Some irrigation equipment is designed to spray water for longer distances, and to shear the water into smaller particles. This causes a significant portion of the water to evaporate in the air, before ever contacting the ground.

If it assumed that the rate of irrigation must be reduced or stopped during the cold months, provision for water storage becomes necessary. In the case of denitrified wastewater being applied over smaller areas, Phases I and II may require winter storage volumes of 350 million gallons (MG) and 494 MG, respectively. In the case of applied effluent with no nitrogen removal, being applied over larger areas, Phases I and II may require winter storage volumes of 206 MG and 360 MG, respectively. Storage would most likely be accomplished using lined, 4-acre ponds, each 20 feet in depth and measuring roughly 140 yards on a side. A pond would store roughly 25 MG. Nitrogen removal would generally not occur in the ponds, since organic material is necessary to fuel denitrification, and most organic material would be removed at the WWTP.

The above storage volumes represent worst-case scenarios for water storage. If it is decided to land-apply the Ruidoso WWTP effluent, the topography, soil characteristics, vegetation, rainfall, snowfall, and type of irrigation equipment should be evaluated. A combination thereof may reduce or even eliminate the need for winter water storage.

Groundwater Injection

WWTP effluent can be discharged to groundwater using injection wells, infiltration, or other methods. Since the discharge would contact the groundwater directly, and not pass through soil or vegetation, the WQCC requires treatment to drinking water standards, which includes a total nitrogen limit of 10 mg/l. Hence, a major plant expansion would still be necessary, along with new systems and new land for injection of effluent to the groundwater.

Conclusion

Alternative 5 may require up to 3,000 acres of land and up to 500 MG of water storage capacity. To reduce the land requirement and possibly to allow for groundwater injection, the effluent would most likely be treated to an effluent TN of 10 mg/l. This is nearly as stringent as the requirements for discharges to the Rio Ruidoso.

The primary benefit of zero-discharge is the elimination of the phosphorus removal requirement, which would eliminate the possible need for a chemical phosphorus removal system. However, the need for nitrogen removal may remain, depending on the area of land available for irrigation, and nitrogen removal would necessitate a major plant expansion.

Alternative 5 presents additional problems such as finding consistent water users or building systems to inject effluent into the groundwater. Finally, Ruidoso would lose the return flow credit it gets by discharging wastewater to the Rio Ruidoso.

Alternative 5 is not considered further.

### 5.2.6 Alternative 6: Alternate Discharge

Alternative 6 would discharge the effluent to a receiving stream with less stringent quality standards. The only such receiving stream is the Rio Hondo, located roughly 20 miles from the plant. The Rio Hondo certainly has a lesser quality standard than the Rio Ruidoso, but the pipeline and pump station would be expensive, and a plant expansion would still be required to meet Rio Hondo discharge standards.

EPA may raise the Rio Hondo standards in the future, which would defeat the point of Alternative 6, and Ruidoso would also lose its return flow credit for discharges to the Rio Ruidoso.

Alternative 6 is eliminated from consideration.

### 5.2.7 Alternative 7: Sequencing Batch Reactors

Sequencing batch reactors are basins that perform all the functions of wastewater treatment in a single basin, using timed cycles. From the headworks, wastewater enters an SBR in which there is already activated sludge left from the previous cycle. For phosphorus removal, the basin is mixed but not aerated, creating conditions similar to those of an anaerobic selector. The reactor then alternates between cycles of aeration and anoxic mixing, for removal of ammonia and nitrate. At the end of the cycle, all aeration and mixing stops, and the reactor functions as a clarifier. After a period of settling, a decanter takes treated water from the top of the basin, and some of the sludge may be wasted.

Sequencing batch reactors can accomplish biological nutrient removal, and they would work for this application, but they are undesirable for the following reasons:

- An SBR system should be monitored continuously, because operation is more intricate, and even if is automated, the complicated operation still makes malfunction more likely, and an operator should be there to fix any problems. But the WWTP is not staffed for 24 hours per day.

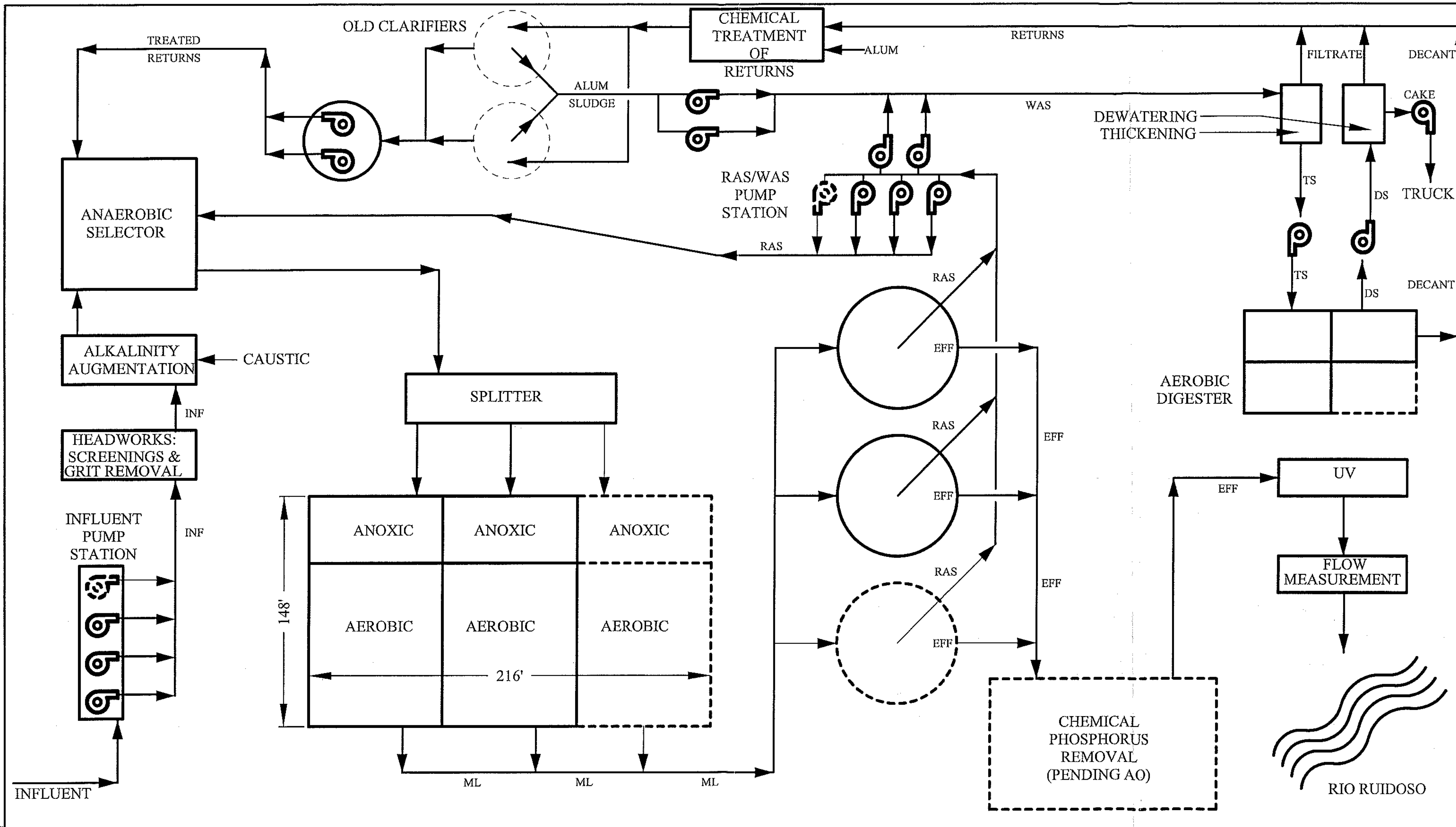
- An SBR system requires more basin volume than a conventional system. First, provision must be made for the time it takes to load and decant the reactors. Second, to avoid sizing the reactors for peak daily flows, the plant requires equalization volume. If equalization is used, aeration must be added to the equalization basin to prevent an odor problem. Such aeration may reduce the incoming ratio of BOD to phosphorus, which would reduce the effectiveness of biological phosphorus removal.

A continuous-flow system would require less space and less operation, and it would not require equalization. Hence, there is no reason to consider SBRs over continuous flow systems. Alternative 7 is not considered further.

## 5.3 Summary of Feasible Alternatives

Of the seven alternatives described in Section 5.2, all but three are eliminated from consideration. All three recycle return-activated-sludge (RAS) to an anaerobic selector ahead of the headworks, for phosphorus removal. All divide flow between two parallel and identical treatment processes for Phase I, with a third parallel process planned for Phase II. The parallel processes are called *trains*, and a train consists of a zoned basin followed by a clarifier, if clarifiers are used. Alternatives 1 through 3 are listed below and summarized in Figures 5-1 through 5-3, respectively:

- **Alternative 1 - Conventional Biological Nutrient Removal (BNR)**
  This alternative proposes a conventional biological nutrient removal (BNR) system. This system proposes to remove nitrogen and phosphorus by following the headworks with an anaerobic selector, to which the return-activated sludge (RAS) is recycled. Flow continues to a pre-anoxic zone, which is mixed but not aerated, causing the biomass to use nitrate instead of oxygen for metabolism of biochemical oxygen demand (BOD). Flow continues to an aerobic zone, where BOD metabolism, ammonification, and

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FUTURE

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Figure 5-1
Alternative 1 - Conventional BNR

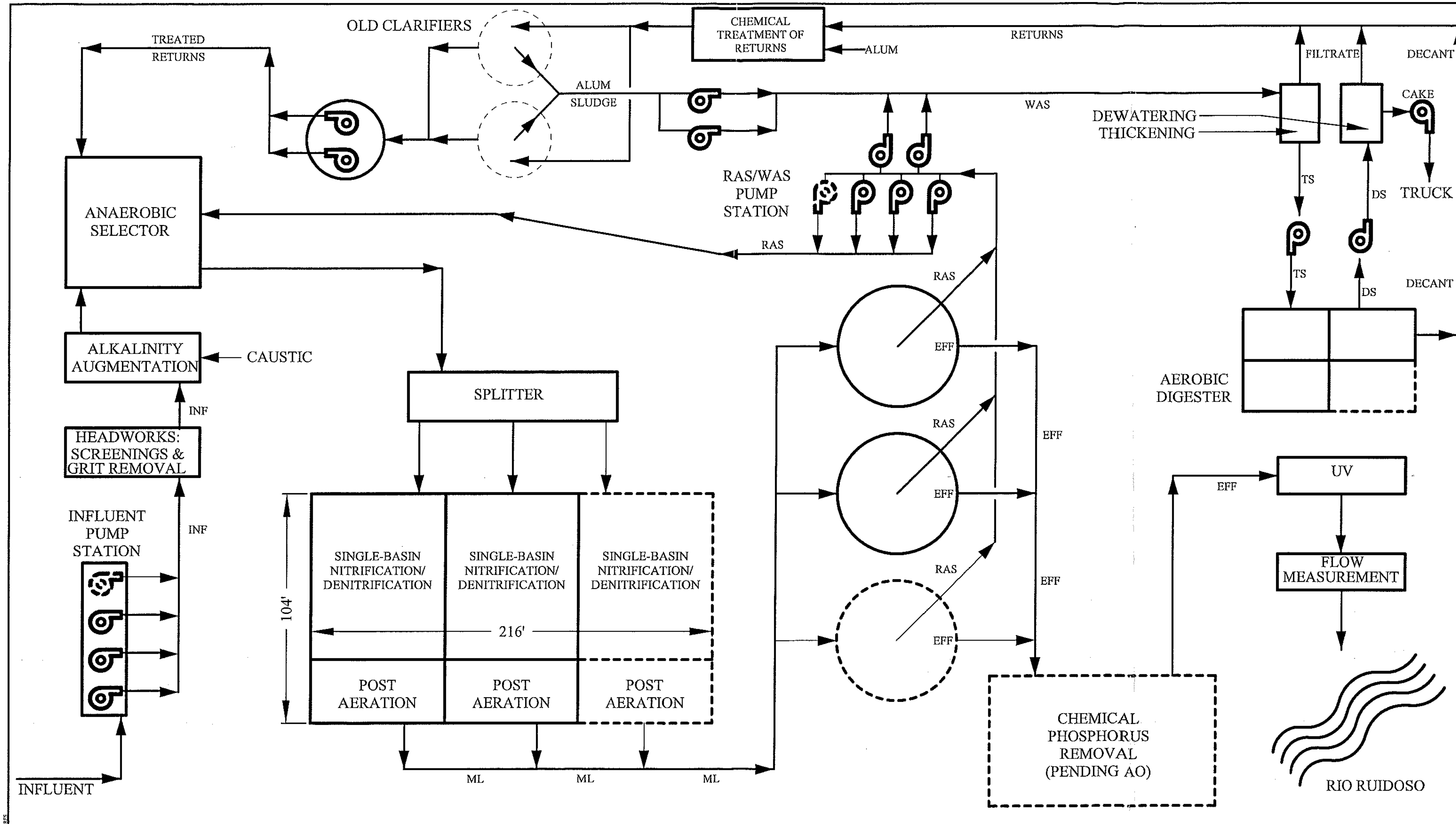


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Figure 5-2
Alternative 2 - Single-Basin Nitrification and Denitrification

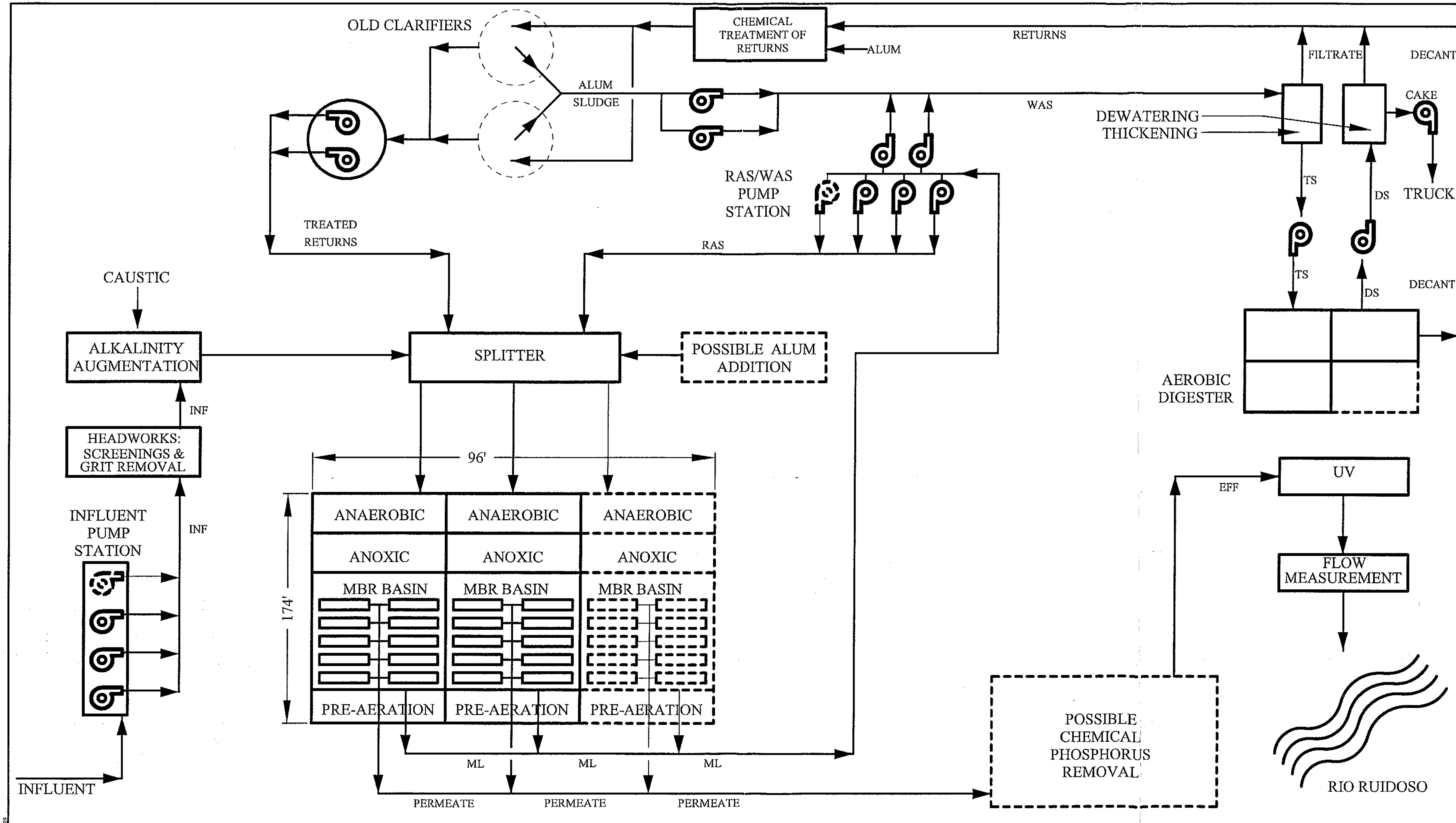


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Figure 5-3
Alternative 3 - Membrane Bioreactors

nitrification take place. Mixed liquor from the aerobic zone is recycled to the anoxic zone. Clarifiers follow the aerobic zone.

- **Alternative 2 - Simultaneous Nitrification and Denitrification**
  This alternative proposes to use a simultaneous nitrification-denitrification (SNdN) process, in which BOD metabolism, ammonification, nitrification, and denitrification take place in the same basin. The use of protein monitoring probes and variable-speed blowers control the concentration of oxygen, making it possible for these processes to occur simultaneously. Flow continues through a post-aeration zone and on to the clarifiers.
- **Alternative 3 - Membrane Bioreactors (MBR)**
  This alternative proposes a conventional BNR process supplemented with membrane bioreactors (MBRs). After passing through anaerobic, anoxic, and aerobic zones, flow continues into a basin compartments containing MBRs. MBR permeate pumps draw permeate through the membranes. RAS and anoxic recycle are taken from the MBR compartment. The membrane filtration eliminates the need for clarifiers.

## 5.4 Description of Common Elements

Alternatives 1 through 3 each have certain processes in common. These are described here so as to avoid repeating them in the descriptions of the individual alternatives. The process flow diagrams provided for Alternatives 1 through 3 show the common elements described in this section.

### 5.4.1 Process Design Basis

Table 5-2 shows the process design basis used for development of Alternatives 1 through 3.

**TABLE 5-2**

**PROCESS DESIGN BASIS**

| | Influent | Effluent |
|---|---|---|
| Phase I Design Flow (mgd) | 2.5 | 2.5 |
| Phase I Two-Hour Peak Flow (mgd) | 6.5 | N/A |
| Phase II Design Flow (mgd) | 3.75 | 3.75 |
| Phase II Two-Hour Peak Flow (mgd) | 9.75 | N/A |
| T (min/max) $^{o}$C | 10 / 21 | N/A |
| BOD5 (mg/l) | 325 | $\leq 30$ |
| TSS (mg/l) | 362 | $\leq 30$ |
| VSS (mg/l) | 307 | N/A |
| TKN (mg/l) | 50 | $\leq 1$ |
| Ammonia Nitrogen (mg/l) | 30 | $\leq 1$ |
| Nitrate Nitrogen (mg/l) | 0 | $\leq 5$ |
| Total P (mg/l) | 8 | $\leq 0.1$ |
| pH | 7.1 | N/A |
| Alkalinity (mg/l) | 270 | N/A |

Note that the BOD and TSS concentrations are more concentrated that that of the wastewater currently loaded to the plant. This is due to anticipated future efforts to conserve water, as well as the possibility of higher commercial growth.

### 5.4.2 Alkalinity Augmentation

The lowest alkalinity reading recently taken from the plant influent was 270 ppm. It is conservatively assumed that this concentration will not change over time, even as other wastewater constituents become more concentrated due to increased use of water saving fixtures. Hence, it must be verified that this influent alkalinity is sufficient to sustain the proposed process, which consumes alkalinity. If the influent alkalinity is not high enough, alkalinity augmentation is necessary.

Using the process design basis of Table 5-2, and accounting for nitrogen that is fixed into the biomass and/or lost in the waste sludge, the nitrification step of the BNR process consumes roughly 273 ppm of alkalinity. The denitrification step restores roughly 118 ppm, leaving an operating alkalinity of 116 ppm in the mixed liquor. This is well above the 50 mg/l necessary to prevent a drop in nitrification rate. Hence, the influent alkalinity is sufficient to sustain the proposed BNR process.

Each feasible alternative recommends an independent, tertiary chemical treatment process downstream of the BNR process. This chemical phosphorus removal system will dose the entire plant throughput with alum, which consumes alkalinity. The anticipated alum dose is 80 ppm, which consumes 36 ppm of alkalinity. This process would reduce the alkalinity of the BNR effluent to 44 ppm, which is sufficient to sustain alum coagulation. Hence, the BNR effluent has sufficient alkalinity to sustain a tertiary chemical treatment process, if the latter becomes necessary. In theory, a tertiary chemical treatment process would not make alkalinity augmentation necessary.

Although it is unlikely that augmentation will be necessary, the following scenarios may make it necessary.

- A plant upset may reduce the rate of denitrification, which restores the alkalinity consumed by nitrification.
- The tertiary alum dose may be higher than 80 ppb.
- Alum may be dosed to the BNR process as well as the tertiary process.
- An iron-based coagulant may be used in lieu of alum. Iron coagulants consume more alkalinity.
- The influent nitrogen concentration may increase beyond the conservative projections herein.
- The influent alkalinity may decrease to below its measured levels.

To account for these possibilities, an alkalinity augmentation system should be seriously considered during the preliminary design phase. The system should be capable of feeding to the headworks and to the head of the tertiary chemical treatment system, if the latter becomes necessary. Prior to the design phase, additional alkalinity readings should be taken to ensure that the plant influent alkalinity is consistent.

The alkalinity augmentation system should be based on soda ash, and not on caustic solution, which is too expensive. A modest alkalinity augmentation of 20 mg/l, if done continuously with caustic solution, would cost up to $488,000 per year at Phase I flow. Soda ash can supply the same dose for as little as $81,000 per year.

Neither of the above costs is included in the operating cost estimates of Section 6, because it is anticipated that alkalinity augmentation will not be necessary. It is only recommended to have an augmentation system on stand-by, in case it is needed due to a plant upset, a change in the process, or a change in wastewater constituents.

### 5.4.3 Influent and RAS Pump Replacement

The influent and RAS lift stations are recommended for demolition, along with their structures and buildings.

A new submersible influent pumping station is constructed at the head of the plant. The basin is sized for Phase II flow, though the pumping capacity is sufficient only for Phase I. The basin has room for the future addition of one or more submersible pumps as necessary to accommodate Phase II flow. Variable-frequency drives are be used, allowing minimization of wet well volume and pump quantity, and allowing the influent pump station to better match the influent flow rate.

New RAS and WAS pumps are installed adjacent to the secondary clarifiers, for Alternatives 1 and 2, and adjacent to the treatment basins for Alternative 3. These pumps are above grade.

### 5.4.4 Replacement of Headworks

As shown in Table 3-1, the existing bar screen does not have sufficient capacity for Phase I flow. Moreover, the bar spacing is too wide for belt thickening and dewatering, which is planned as described in subsequent sections. Hence, the screening must be replaced with finer screening of higher capacity.

Table 3-1 shows that the existing grit chamber is adequate for Phase I but too small for Phase II. Hence, the grit chamber could be reused for Phase I, but it would require replacement by the end of the planning period.

Ideally, the screening and grit removal processes should be as high as possible to maximize the plant hydraulic profile, thus minimizing the bury depth required for large basins, and allowing for the possible future addition of chemical removal for the plant throughput. Both processes should be on the same structure, and each should last as long as the other, which is not the case here since the bar screens require replacement for Phase I, whereas the grit chamber is suitable for Phase I. For these reasons, Alternatives 1 through 3 each replace both the screening and grit removal processes.

The new screening process handles existing flow without allowing too small a channel velocity, and it handles Phase II flow without allowing too high an intra-bar velocity. This is accomplished with a three-channel structure. For Phase I, a channel is blocked off using slide gates. A mechanical screen is installed in one channel, and a manual bypass screen is installed in the third channel. For Alternatives 1 and 2, the bars have 1/4$^{th}$-inch spaces between. For Alternative three, bars with 1-mm spaces are necessary to protect the MBRs. For Phase II, the previously blocked channel is opened and fitted with a second mechanical screen.

The screening channels are roughly 2.5 feet wide and four feet deep. The parallel channels rest atop a concrete room that houses the grit pumps, which sit on a floor that matches grade.

The proposed grit chamber uses the existing grit classifier, and a new basin with a bypass. The basin is buried just deeply enough to eliminate the need for structural supports, and it is connected to the pump room that supports the screening channels. The grit chamber, screening channels, and pump room form a single structure that sits on the highest available ground.

### 5.4.5 Anaerobic Selector

Alternatives 1 and 2 require installation of an anaerobic selector downstream of the headworks and upstream of a proposed new splitter box. Alternative 3 recommends that the individual aeration basins each be equipped with an anaerobic zone, downstream of the splitter. This section describes the anaerobic selector recommended for Alternatives 1 and 2. The anaerobic zones recommended for Alternative 3 are discussed in the description of that alternative.

The anaerobic selector is a serpentine contact basin designed for a hydraulic residence time (HRT) of 1.5 hours at Phase II flow, resulting in an HRT of 2.25 hours for Phase I. The cost of the anaerobic selector is determined as such, although this cost could be reduced if the selector were designed for 1.5 hours at Phase I flow and then expanded for Phase II.

The volume of the proposed anaerobic selector is roughly 240,000 gallons. The basin has multiple passes, with the first being used to remove dissolved oxygen and nitrate from the RAS. Headworks effluent is introduced at the start of the second pass. Each pass is equipped with a mixer aimed opposite the direction of flow.

### 5.4.6 Clarifiers

Alternatives 1 and 2 use secondary clarifiers downstream of the aeration basins. The clarifiers are 80 feet in diameter with 16 feet sidewater depth. The clarifiers are centrally driven, in contrast to the peripheral drives on the existing clarifiers, which are problematic due to snow buildup on the sidewalls. Phase I uses two clarifiers, and a third will be installed for Phase II.

The proposed clarifiers have flat bottoms and are designed to have minimal sludge blanket. This minimizes the residence time of the biomass in the clarifier, ensuring that the bacteria remain healthy.

### 5.4.7 UV Disinfection

For reasons described in Section 3, the existing chlorination/dechlorination system is replaced with UV disinfection. The existing chlorine contact tank is demolished to below ground level, and the remainder is filled in. A new UV Building is erected at grade and just east of the existing chlorine contact chamber. A single secondary effluent pipe enters the building and splits into two branches, each with an in-line UV disinfection unit that looks similar to a mixing tee. Each is designed for all plant throughput, so that one can be used for a standby. For Phase II, the units will be removed and replaced with more powerful units.

### 5.4.8 Mechanical Belt Thickening

For reasons discussed in Section 3, Alternatives 1 through 3 recommend replacement of the existing gravity thickener for the following reasons:

- The existing drive is broken, and due to the expense of repairing it, it has not been repaired.
- If it functioned as intended, it would still be a problem due to snow accumulation on the basin sidewalls, and the salt used for snow removal would continue to corrode the concrete.
- Replacement of the peripheral drive with a center drive would be costly.
- The thickener occupies high, finished ground that could be used for the headworks, thus maximizing the plant hydraulic grade line.
- Due to the residence time of sludge in the thickener, odor problems have been reported.

For these reasons, it is proposed to replace the gravity thickener with a 2-meter mechanical belt thickener. WAS would be pumped to the belt and thickened to 5 percent, before passing onto the aerobic digester. Belt thickening is beneficial for the following reasons.

- Belt-thickened sludge is generally thicker than that produced by gravity thickening, and thicker sludge results in a smaller digester.
- A belt thickener requires far less space than a gravity thickener.
- The residence time through a belt thickener is negligible, so the sludge would not have time to go anaerobic and cause odor problems.

- The short residence time also results in healthier biomass sent to the digester, where more biological activity is expected.

The proposed two-meter belt thickener handles 400 gpm of flow, and it must handle about this amount of flow regardless of the actual amount of sludge to be wasted. Hence, the amount of sludge to be wasted determines the amount of time spent wasting and thickening the sludge.

For determination of sludge application rates, it is assumed that the secondary clarifier effluent is dosed with 80 mg/l of alum and then routed to tertiary clarifiers. The alum sludge produced is such that eight percent of the total applied sludge is alum sludge.

For Phase I, the sludge application rate is roughly 5,700 lb/d dry solids, or 58 gpm. Assuming a 5-day workweek, the thickener requires operation for five hours per day.

For Phase II, the sludge application rate will be roughly 8,530 lb/d dry solids, or 90 gpm. Assuming a five day workweek, the thickener will require operation for roughly seven hours per day.

For both phases, the belt thickener captures roughly 98 percent of the sludge, and the thickened concentration is roughly 5 percent solids.

### 5.4.9 Aerobic Digestion

The existing aerobic digester is part of a four-basin structure, and it has been recommended previously that the entire structure not be reused and instead demolished. The required aerobic digestion and the regulations thereof reinforce the case for demolishing this existing structure, and for building a new digester.

As described in Section 3.2.3, the Code of Federal Regulations (40 CFR 503) governs the surface disposal of sludge, as intended by Ruidoso. By the Code, the sludge must meet two principle requirements before it is classified as Class A or Class B, thus qualifying for surface disposal.

- The number of pathogens, or disease-causing microorganisms, must be reduced. By the Code, this can be accomplished through aerobic digestion with a solids residence time (SRT) of 60 days at a temperature of 15 $^0$C. Alternatively, it can be accomplished with composting, or by directly measuring the pathogen levels in the finished sludge, as is currently done at Ruidoso. Because Ruidoso has consistently met Class A requirements through direct pathogen measurement, and because Ruidoso plans to compost its dewatered sludge, the SRT of 60 days is not considered necessary.
- The vector attraction of the sludge must be reduced. In other words, the sludge must not attract insects, birds, or other animals. There is no analytical method to verify that vector attraction has been reduced, but by the Code, the sludge can meet this requirement if a process such as aerobic digestion reduces the sludge mass by 38 percent. Assuming a minimum water temperature of 15 $^0$C, an SRT of 28 days is necessary to meet this requirement. Hence, the digester is sized on this basis.

For Phase I, the basin volume required for a 28-day SRT is 335,000 gallons, assuming a feed sludge concentration of 5 percent. For Phase II, this volume increases to 502,000 gallons.

Since the existing digester has sufficient volume for Phase I requirements, it had been considered to reuse it for Phase I, then perhaps one of the aeration basins for Phase II. However, a new digester is considered preferable for the following reasons:

1. A 28-day digester SRT is sufficient provided that the water temperature in the digester can be maintained at 15 $^0$C with an incoming wastewater temperature of 10 $^0$C. This is a reasonable assumption given that aerobic digestion produces heat, and sufficient temperature can be maintained in a deep basin provided it is covered. But in a shallow basin that uses surface aeration, more surface area is exposed to the cold air above, and surface aeration causes evaporative cooling, which lowers the temperature further. At best, one could maintain a

digester temperature that was the same as that of the incoming wastewater, or 10 $^0$C. At this temperature, the required digester SRT is 42 days, which would require a volume of 521,000 gallons for Phase I and 780,000 gallons for Phase II. It would be necessary to convert another of the existing basins for use in digestion.

2. The aerators of the existing digester and aeration basins are not sufficient for use in digestion. They have fixed height, so aeration stops when the digester is decanted. For proper function, the existing digester and an aeration basin would require retrofit with floating aerators that would be able to deliver enough air and keep the solids suspended. Moreover, an aeration basin would have to be fitted with a decanter. The substantial investment in these existing basins is not recommended given the age of the basins and questions regarding the integrity of the structure.
3. Shallow basins require a great deal of space for a given volume, and space on the plant is limited unless Ruidoso can acquire new land. Depending the alternative selected, the plant may not have sufficient space for the existing treatment structure, the future aeration basins, the future clarifiers, if used, and the phosphorus removal system that may be required for plant throughput. For all these systems to be installed on the current site, it may be necessary to remove the existing structure.
4. The proposed new digester uses a three-compartment design, which has the following benefits:
    a. The digester feed consists mainly of biomass, or bacteria cells wasted from the activated sludge process. Aerobic digestion facilitates *endogenous decay*, in which the bacteria feed upon themselves. When bacteria metabolize other bacteria, the organic nitrogen contained in the mass of the consumed cells is converted to ammonia, which is then oxidized to nitrate. It is preferable to remove this nitrate from the digester, thus reducing the nitrogen content of the finished sludge, as well as that of the decant returned to the head of the plant. To this end, aeration to a given compartment is stopped at certain intervals, with mechanical mixing used to maintain the particle suspension. This allows denitrification in the anoxic compartment, while one or both of the other compartments is still aerobic. When the nitrate supply in the anoxic compartment is exhausted, aeration of that compartment is restarted, producing more nitrate to be used in the next anoxic cycle. This alternation between

aerobic and anoxic respiration takes place in all three compartments at different times.

b. The proposed digester uses only one of the compartments for decanting and wasting, so that aeration can continue in the other two compartments while the third is being pulled down.

c. The three-chamber concept facilitates future expansion. As shown in the schematic diagrams presented in this Section, the three compartments form three parts of a square, so when the plant is expanded, a fourth compartment will be built by adding the two walls necessary to complete the square.

5. A new digester can be placed closer to the proposed thickening and dewatering building, which will be located next to the existing sludge drying beds, on the opposite side of the plant from the existing digester.

The proposed Phase I digester is a three-compartment structure, consisting of a center square compartment with additional square compartments on the south and east sides. In plan view, as shown on the schematics, the three compartments make up 3/4ths of a square structure. The fourth part will be added for Phase II. Each compartment has an interior dimension of 28 feet by 28 feet, with a 22-foot sidewater depth and 2 feet of freeboard. The structure is installed above ground, which is easily possible since positive-displacement pumps feed the digester and draw from it. The high water surface also aids in the drainage of decant to the plant returns system, which is discussed further in this Section.

5.4.10 Mechanical Dewatering

A positive-displacement pump draws sludge from the digester and feeds it at roughly 150 gpm to a proposed belt press. Since the compartment used for wasting can be settled and decanted prior to wasting, without stopping digestion altogether, it is assumed that the digested sludge has the same concentration as the sludge fed to the digester. In reality, the digested sludge may be more concentrated than the feed sludge, but for design, it is most prudent to assume that the digested sludge has the same concentration as the belt-thickened sludge, or roughly 5 percent.

The proposed two-meter belt press handles 1,600 lb/h of digested sludge, on a dry-solids basis. It must handle about this flow rate regardless of the actual mass of sludge to be dewatered. Hence, the amount of sludge to be dewatered determines the amount of time spent running the press.

For determination of sludge application rates, it is assumed that the secondary clarifier effluent is dosed with 80 mg/l of alum and then routed to tertiary clarifiers. The alum sludge produced is such that eight percent of the total applied sludge is alum sludge.

For Phase I, the digester wasting rate is roughly 3,900 lb/d dry solids. Assuming a 5-day workweek, the belt press requires operation for 3.5 hours per day.

For Phase II, the digester wasting rate will be roughly 6,200 lb/d dry solids. Assuming a five day workweek, the belt press will require operation for roughly 5.5 hours per day.

For both phases, the belt press captures roughly 98 percent of the sludge, and the thickened concentration is roughly 19 percent solids.

### 5.4.11 Finished Sludge Processing

Alternatives 1 through 3 recommend a new building to house the belt thickener and belt press. This building is to be located east of the Administration Building and be equipped with an indoor truck-loading bay. A conveyor moves dewatered sludge from the press to a hopper over the unloading bay, from which it can be transferred by gravity to a waiting vehicle.

The current plan is for a private customer to remove the plant sludge at no cost to Ruidoso. The customer plans to mix the sludge with solid waste from Ruidoso Downs and compost the two. Alternately, Ruidoso can use its existing sludge drying beds for windrow composting, since it already has a windrow-turning machine. The plant operators have successfully done this, achieving thermophilic temperatures within the compost and producing Class A sludge.

5.4.12 Parallel Aeration Processes

Alternatives 1 through 3 each use parallel aeration processes, or trains. For Phase I, each uses two aeration trains, each rated for 1.25 mgd. Alternatives 1 and 2 each use two clarifiers, each rated for 1.25 mgd. For Phase II, a third train will be added. The third train will be identical to the first two trains. For Alternatives 1 and 2, the third train will contain a third clarifier.

5.4.13 Chemical Phosphorus Removal

Ruidoso sought to raise the effluent phosphorus limit from 0.1 mg/l to 1.0 mg/l through implementation of a "Water Quality Trading Program." However, after exploring such a program with a consultant, Ruidoso determined that the program would not be feasible. Because Ruidoso is now committed to constructing and operating a plant capable of meeting the 0.1 mg/l effluent phosphorus limit, the discussion in this Section 5.4.13 concerning the impact of a 0.1 mg/l versus a 1.0 mg/l limit is presented only as background information. Each effluent standard requires a different approach to chemical phosphorus removal.

- If the effluent phosphorus limit is raised to 1 mg/l, a small chemical precipitation system is installed for removal of phosphorus from the plant returns, which consist of digester decant, belt thickener filtrate, and belt press filtrate. This is done to enhance the biological phosphorus removal system presented for all three alternatives, ensuring that the plant consistently meets the 1 mg/l standard. Figure 5-4 summarizes this system.
- If the effluent phosphorus limit remains at 0.1 mg/l, an independent, tertiary chemical process is installed downstream of the activated sludge process. This chemical phosphorus removal system treats the entire plant throughput, reducing effluent phosphorus to 0.1 mg/l or less. Return flows are routed to the head of the chemical system, and not to the head of the plant, so the return flows are not treated separately, as they would be for an effluent standard of 1 mg/l. Figure 5-5 summarizes this system.

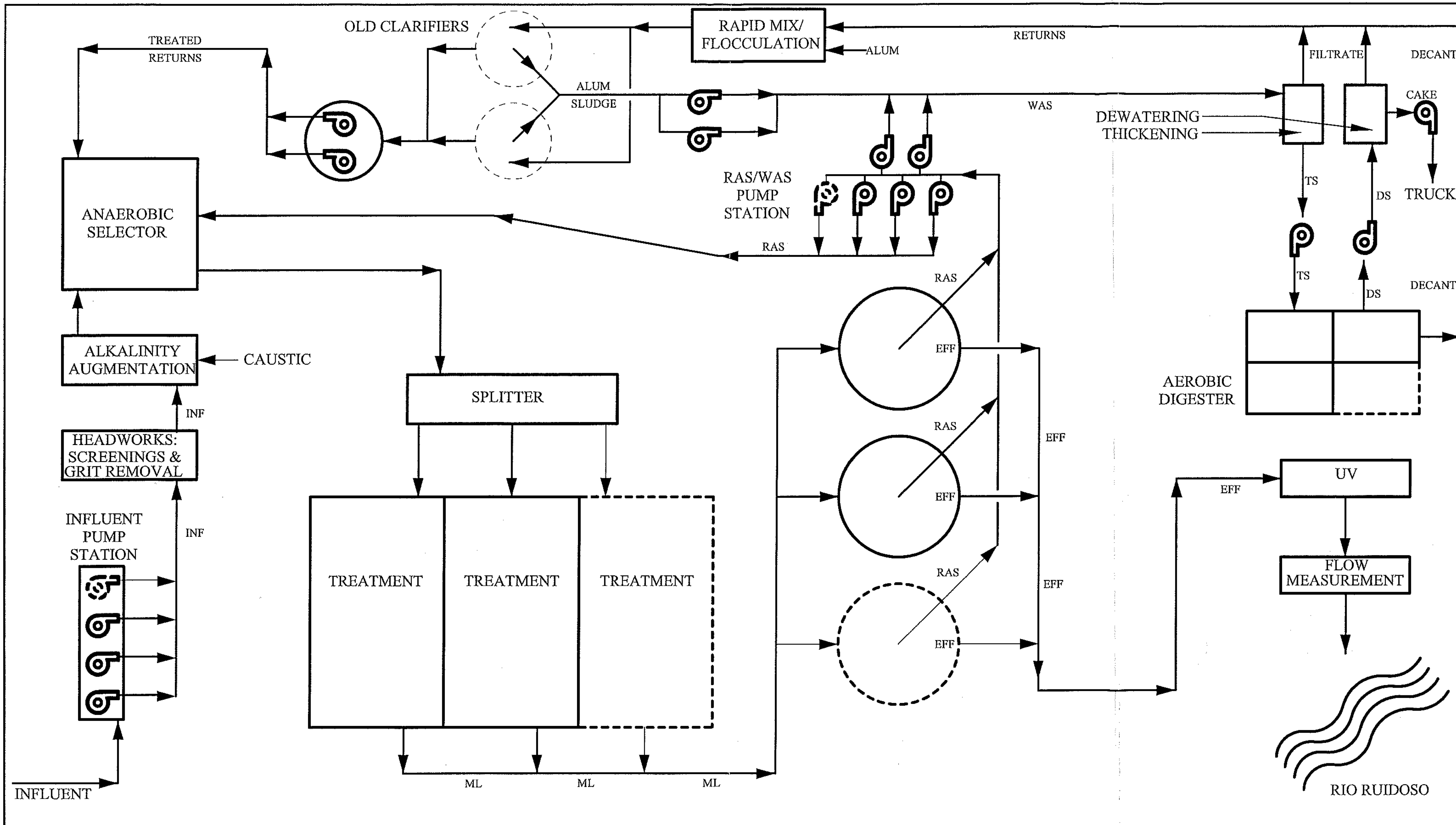


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Figure 5-4
Phosphorus Removal to 1mg/L

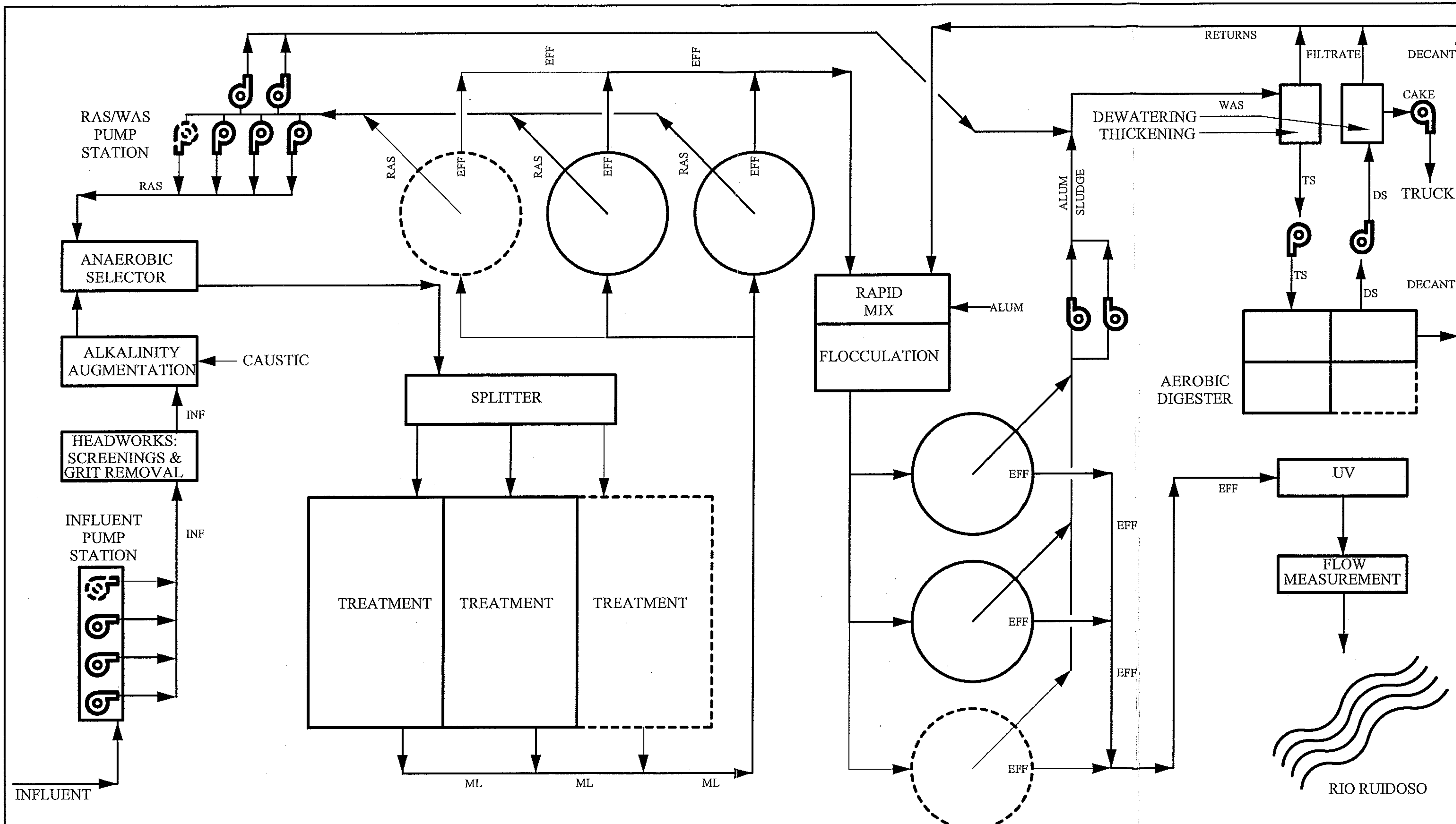


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Figure 5-5
Phosphorus Removal to 0.1 mg/l

## Chemical Phosphorus Removal

The most common mode of chemical phosphorus removal from water is *chemical precipitation.* The phosphorus-rich water flows to a modular chemical treatment process containing a rapid-mix compartment and a flocculation compartment. In the rapid-mix compartment, concentrated alum is dosed to the water, which is mixed thoroughly for roughly five minutes to ensure even dispersal of the alum. The alum reacts with the phosphorus to form an insoluble salt that precipitates into suspended, solid particles, along with suspended organic solids to which the alum attaches.

The mixture continues to the flocculation compartment, where mixers gently stir the water, causing collisions between the particles in which the particles stick together to form larger particles, which are called floc particles. In this compartment, mixing is just vigorous enough to ensure particle collisions and prevent sedimentation, but it is not so vigorous as to break apart, or shear, the floc particles formed.

From the flocculation compartment, the water flows to a physical separation process, which is usually gravity settling or direct filtration. For the analyses herein, gravity settling is assumed, although direct filtration will be evaluated further during preliminary design.

Alum sludge is drawn from the bottom of the clarifier and blended with the organic sludge. The clarifier overflow is relatively low in phosphorus.

## Effluent Limit of 1.0 mg/l

Compliance with an effluent limit of 1 mg/l is achieved mainly with an anaerobic selector. In the anaerobic selector, aerobic bacteria absorb phosphorus, but the phosphorus does not become part of the cell mass. During digestion, thickening, and dewatering, it is possible for the bacteria to release some of the phosphorus taken up in the anaerobic selector. Hence, the return flow may be laden with phosphorus, and the phosphorus in the return flow may overwhelm the anaerobic selector and compromise the ability of the plant to maintain a discharge standard of 1 mg/l. To guard against this, it is recommended to remove phosphorus from the plant return flow using a small chemical treatment system.

For purposes of this report, miscellaneous flows to the plant drain system are not considered return flows. Only the digester decant, thickener filtrate, and belt press filtrate are considered return flows.

As shown in Figure 5-4, the return flows drain to a modular system consisting of a rapid mix basin with alum feed, and a flocculation basin. The flow drains to the existing secondary clarifiers, which are converted for use in chemical precipitation. Clarifier overflow is pumped to the anaerobic selector using a new duplex pump station. The alum sludge is combined with the waste activated sludge and sent for processing. The alum sludge constitutes an insignificant portion of the total sludge mass.

To convert the existing clarifiers for use in chemical precipitation, it is necessary to replace the drive units and repair the concrete atop the sidewalls, which has been corroded by salt used for snow removal. The new drives are driven from the center.

The chemical treatment module, as well as the existing secondary clarifiers, are adequate for chemical precipitation of Phase I and Phase II return flows.

Effluent Limit of 0.1 mg/l

For an effluent limit of 0.1 mg/l, chemical treatment of the entire plant throughput is required. This is accomplished with an independent, tertiary chemical precipitation system, as shown in Figure 5-5. Plant returns are not treated separately, and are instead routed to the head of the chemical precipitation process, and not to the head of the plant.

As shown in Figure 5-5, the secondary clarifier overflow drains to a modular system consisting of a rapid mix basin with alum and polymer feed, and a flocculation basin. The basins are adequate for Phase I and Phase II plant flows.

The flow drains to new tertiary clarifiers, each roughly 80 feet in diameter. Two are required for Phase I flow, and a third is required for Phase II flow. In lieu of clarifiers, the flocculator effluent may be filtered directly. This will be evaluated further during preliminary design.

Clarifier overflow drains to the disinfection system. Some of the alum sludge is recovered and reused. The remaining alum sludge is combined with the waste activated sludge and sent for processing. The alum sludge constitutes about eight percent of the total sludge mass.

It may be possible to add coagulant directly to the mixed liquor, and thereby avoid a tertiary process. This will be evaluated further during preliminary design. For purposes of this PER, a tertiary process is assumed.

Determination of Chemical Treatment Requirements

Alternatives 1 through 3 allow for the installation of either a returns treatment system or a throughput treatment system. The alternatives leave room for a throughput treatment system, and each arranges the plant so that a system can be placed between secondary treatment and disinfection. Each alternative uses sludge presses and a digester that can accept the alum sludge that throughput chemical treatment would generate. Finally, Alternatives 1 and 2 leave roughly 14 feet of spare hydraulic head, and Alternative 3 leaves roughly 17 feet of spare hydraulic head. Since 14 feet is enough head to drive the throughput through a chemical treatment process without pumping, Alternatives 1 through 3 are considered equal as regards the available hydraulic head for chemical treatment.

Hence, if throughput treatment is required, it will be possible to install a tertiary chemical process.

### 5.4.14 Upgrade of Plant Controls

Alternatives 1 through 3 propose systems that are too complex to be managed by the existing control system at the plant. For management of the new system, it will be necessary to install a new *distributed control system*, or DCS.

A DCS consists of *programmable logic controllers* (PLC) located throughout the plant at the various unit processes. A PLC is a small computer used to control a given process. It is like a desktop computer, but smaller, more simple, and infinitely more reliable. For processes such as the presses or the headworks, the vendor generally supplies a PLC programmed to run the equipment. These PLCs report to a *field interface unit* (FIU), which is a PLC set in a central location. A local *systems integrator* supplies the FIU and ties it to the individual PLCs supplied by the vendors. The FIU is also programmed to control the plant unit processes for which the vendors did not supply PLCs, such as the influent or return sludge pump stations.

The systems integrator provides a *man-machine interface* (MMA), which is a desktop computer equipped with control software such as Wonderware or DMACs. The integrator connects the MMA to the FIU, programming the MMA software so that operators, from a central location, can monitor the plant and set the operating parameters. Moreover, the MMA is set up to page or call plant operators if a plant upset occurs during a time when the plant is not staffed. The systems integrator instructs the plant in the use of the control system, and because a local company is normally used, the integrator is available to visit the plant and address any problems with the overall control system.

### 5.4.15 Administration/Operation Building

Alternatives 1 through 3 propose a new building located close to the existing O&M Building. The new building is proposed to avoid the need for modifications to the existing building, which would require bringing the existing building into compliance with all codes.

The new building should have a women's washroom, new laboratory, and a new control station.

## 5.5 Alternative Comparison

Alternatives 1 through 3 are listed below and summarized in Figures 5-1 through 5-3, respectively:

- **Alternative 1 - Conventional Biological Nutrient Removal (BNR)**
  This alternative proposes a conventional biological nutrient removal (BNR) system. This system proposes to remove nitrogen and phosphorus by following the headworks with an anaerobic selector, to which the return-activated sludge (RAS) is is recycled. Flow continues to a pre-anoxic zone, which is mixed but not aerated, causing the biomass to use nitrate instead of oxygen for metabolism of biochemical oxygen demand (BOD). Flow continues to an aerobic zone, where BOD metabolism, ammonification, and nitrification take place. Mixed liquor from the aerobic zone is recycled to the anoxic zone. Clarifiers follow the aerobic zone.
- **Alternative 2 - Simultaneous Nitrification and Denitrification**
  This alternative proposes to use a simultaneous nitrification-denitrification (SNdN) process, in which BOD metabolism, ammonification, nitrification, and denitrification take place in the same basin. The use of protein monitoring probes and variable-speed blowers control the concentration of oxygen, making it possible for these processes to occur simultaneously. Flow continues through a post-aeration zone and on to the clarifiers.
- **Alternative 3 - Membrane Bioreactors (MBR)**
  This alternative proposes a conventional BNR process supplemented with membrane bioreactors (MBRs). After passing through anaerobic, anoxic, and aerobic zones, flow continues into a basin compartments containing MBRs. MBR permeate pumps draw permeate through the membranes. RAS and anoxic recycle are taken from the MBR compartment. The membrane filtration eliminates the need for clarifiers.

Alternatives 1 through 3 are compared and ranked according to the criteria set forth in Section 5.1. For each alternative, the rankings for each criterion are summed, and that with the highest score is recommended and examined further in Section 6. The system of rankings uses three scores:

- The more favorable alternative is given a score of 1.
- An alternative that is neither favorable nor unfavorable is given a score of 2.
- The less favorable alternative is given a score of 3.

### 5.5.1 Regulatory Compliance

Each alternative presents an identical system for phosphorus removal, but it is preferable if some phosphorus uptake also occurs in the treatment basins, as these can serve as somewhat of a backup to the anaerobic selector.

Alternatives 1 and 3 both use anoxic zones for denitrification, and in this oxygen-deprived environment, the floc relies on nitrate for BOD reduction. But not all nitrate makes it to the interiors of the floc particles, so anaerobic zones form within the interiors of some particles, resulting in phosphorus uptake in the anoxic zones. Since both Alternatives 1 and 3 use anoxic basins, each is given a favorable rating of 1.

Alternative 2 does not use an anoxic zone, but rather tight control of the dissolved oxygen concentration to create anoxic zones within the floc interiors. The process can be controlled such that anaerobic zones can be formed farther inside the interiors of the floc particles, resulting in phosphorus uptake. This uptake is not as reliable as that of an anoxic basin, because there is some dissolved oxygen in the basin, but the phosphorus uptake is not sufficiently less reliable to warrant a lesser rating than Alternatives 1 and 3. Hence, Alternative 2 is also given a favorable rating of 1.

### 5.5.2 Expandability

Alternatives 1 and 2 are not significantly different with respect to expandability. They differ only in the design of their aeration basins, and each uses two basins operating in parallel, with provision made for the future addition of a third basin. Each uses two secondary clarifiers, with provision made for future addition of a third. The future addition of a third basin and a third clarifier will not be especially difficult, nor especially easy, so Alternatives 1 and 2 are given a rating of 2.

Alternative 3 is more easily expanded than Alternatives 1 and 2, because it does not use secondary clarifiers, so the future expansion does not require the building of an 80-foot clarifier and associated yard piping. Hence, Alternative 3 is given a rating of 1.

### 5.5.3 Site Efficiency and Constructability

Alternatives 1 and 2 are identical in all regards other than the aeration basin design. Neither is especially favorable or unfavorable, so both Alternatives are given a rating of 2.

Alternative 3 is more site efficient and more easily constructed because it does not require secondary clarifiers. The alternative receives a ranking of 1.

### 5.5.4 Operation and Maintenance

Alternative 1 is the most simple and most common of the three alternatives. It requires no special controls, operation, nor maintenance apart from that required for an ordinary BNR plant. Hence, it is given a ranking of 1.

Alternative 2 requires slightly more complicated operation than Alternative 1, since it uses probes, variable-frequency blowers, and an analog control loop for precise control of dissolved oxygen in the basins. However, reports from operators of the process suggest that although the control is difficult, it is not unduly difficult, and not drastically more difficult than operation of a typical process. Hence, it is also given a ranking of 1.

For the following reasons, Alternative 3 is given a lesser ranking for operation and maintenance.

- For protection of the membranes, a major manufacturer of MBRs insists that the headworks bar screen have openings no greater than one millimeter, or 1/25th inch. In contrast, Alternatives 1 and 2 allow screen openings of $1/4^{th}$ inch, or over 6 millimeters. The unusually fine screen required for MBRs would undoubtedly capture much of the biodegradable matter that should rightfully be applied to the aeration basins, and the disposal of this matter would be a significant problem. It would also be difficult to keep the screen free of clogs.
- Phase I requires the installation of 60 cassettes, and each individual cassette requires monitoring and maintenance. When a membrane rupture occurs, it registers as an increase in turbidity of the permeate, and the staff must find which of the 60 cassettes has the problem.
- Phase I requires five variable-speed permeate pumps to draw clean water through the cassettes, and each is rated for 430 gpm. This contrasts with Alternatives 1 and 2, in which water flows by gravity to a clarifier and on to disinfection.

For these operational difficulties and complex control system and MBR plant would require, it is assigned a ranking of 3.

### 5.5.5 Public Acceptance

None of the alternatives produce excessive odor, and none are particularly hazardous to the safety of plant workers or the public. All alternatives meet the permit, and all processes are established as effective and reliable for wastewater treatment to the permitted standards. Hence, all alternatives receive a ranking of 2.

### 5.5.6 Cost Considerations

For Alternative 1, Tables 5-3 and 5-4 show the approximate calculations of capital and operating costs, respectively. For Alternative 2, Tables 5-5 and 5-6 show the approximate calculations of capital and operating costs, respectively. For Alternative 3, Tables 5-7 and 5-8 show the approximate calculations of capital and operating costs, respectively.

**For ease of comparison, the cost estimates presented in this section are based on an effluent phosphorus limit of 1.0 mg/l. This basis for comparison results in the following assumptions.**

- Each cost estimate includes the cost of a system for chemical treatment of returns.
- No cost estimate for a throughput chemical treatment system is included.
- An alkalinity augmentation system is included in case augmentation becomes necessary in the future. However, it is assumed that alkalinity augmentation will normally not be required, so the cost of soda ash is not included in the operating cost.
- The alum cost is not included in the operating cost, since the amount of alum added is minimal for returns treatment.
- The operating costs do not include the cost of hiring additional operators, which may be necessary.

**Section 6 presents the added cost of reducing effluent phosphorus to 0.1 mg/l.**

## TABLE 5-3
## ALTERNATIVE 1 CONCEPTUAL CAPITAL COST

| Construction Costs | Amount |
|---|---|
| Anaerobic Selector with Alkalinity Augmentation | $559,000 |
| Aeration Basin and Blowers/Canopy Structure | $4,586,000 |
| Influent Pump Station | $1,332,000 |
| Secondary Clarifiers | $1,520,000 |
| Mechanical Dewatering Facilities | $1,776,000 |
| Aerobic Digester and Blower Structure | $1,227,000 |
| Chemical Precipitation Filtrate - Phosphorus Removal | $775,000 |
| Phosphorus Filtrate Pump Station | $234,000 |
| UV Disinfection Building | $656,000 |
| Yard Piping Improvements | $439,000 |
| Site Improvements | $176,000 |
| Headworks | $706,000 |
| RAS/WAS Pump Station | $594,000 |
| Laboratory and Administration/Control Building | $1,355,000 |
| Electrical | $1,753,000 |
| Laboratory Testing Services | $100,000 |
| Subtotal | $17,788,000 |
| | |
| Other Support Facilities: | |
| Building in lieu of Blower Canopy | $620,000 |
| Demolition | $1,441,000 |
| Subtotal | $2,061,000 |
| | |
| Subtotal of New Facilities | $19,849,000 |
| Construction Contingencies @ 10% | $1,985,000 |
| Subtotal | $21,834,000 |
| | |
| NMGRT @ 7.6875% | $1,678,000 |
| Total Construction Costs | $23,512,000 |
| | |
| **Professional Engineering Services Allowance @ 9.5%** | |
| Basic design services and allowance for special services including construction inspection (18 months), soils investigation, surveys, aerial mapping, operation and maintanance manual, and startup services | $2,234,000 |
| | |
| NMGRT @ 6.75% | $151,000 |
| Total Professional Engineering Services | $2,385,000 |
| | |
| **Total Project Costs** | $25,897,000 |

**TABLE 5-4**
**ALTERNATIVE 1 CONCEPTUAL O&M COST**

| ITEM | QUANTITY | UNIT PRICE ($/kWh) | COST ESTIMATE ($/yr) |
|---|---|---|---|
| Influent Pumps | 725.28 | $0.08 | $21,193 |
| Bar Screen | 11.4 | $0.08 | $333 |
| Screenings Conveyor/Compactor | 15.05 | $0.08 | $440 |
| Grit Classifier | 7.6 | $0.08 | $222 |
| Grit Lift Pumps | 30.43 | $0.08 | $889 |
| Aerated Grit Blowers | 204.11 | $0.08 | $5,964 |
| Anaerobic Selector Mixers | 91.2 | $0.08 | $2,665 |
| Anoxic Selector Mixers | 365.24 | $0.08 | $10,672 |
| Aeration Basin Blowers | 5013.12 | $0.08 | $146,483 |
| Final Clarifiers | 12 | $0.08 | $351 |
| UV Units | 1440 | $0.08 | $42,077 |
| Aerobic Digester Blowers | 2341.84 | $0.08 | $68,429 |
| Returns Rapid Mixer | 115.2 | $0.08 | $3,366 |
| Returns Flocculator | 15.12 | $0.08 | $442 |
| Returns Clarifiers | 12 | $0.08 | $351 |
| RAS Pumps | 544.28 | $0.08 | $15,904 |
| Scum Pumps | 60.88 | $0.08 | $1,779 |
| WAS Pumps | 14.21 | $0.08 | $415 |
| Thickened Sludge Pump | 2.56 | $0.08 | $75 |
| Digested Sludge Pump | 4.57 | $0.08 | $134 |
| Alum Sludge Pump | 9.89 | $0.08 | $289 |
| Returns Pump | 29.05 | $0.08 | $849 |
| Chemical Feed Pumps | 24 | $0.08 | $701 |
| Belt Thickener | 40 | $0.08 | $1,169 |
| Belt Press | 31 | $0.08 | $906 |

| | | |
|---|---|---|
| Subtotal System Operation | $ | 326,096 |
| Subtotal System Maintenance (Estimate 1% of capital cost) | $ | 258,970 |
| **TOTAL ($/yr)** | $ | 585,000 |
| **Present Worth** | $ | 8,705,000 |

## TABLE 5-5
## ALTERNATIVE 2 CONCEPTUAL CAPITAL COST

| Construction Costs | Amount |
|---|---|
| Anaerobic Selector | $559,000 |
| Aeration Basin and Blowers/Canopy Structure | $3,986,000 |
| Influent Pump Station | $1,332,000 |
| Secondary Clarifiers | $1,520,000 |
| Mechanical Dewatering Facilities | $1,776,000 |
| Aerobic Digester and Blower Structure | $1,227,000 |
| Chemical Precipitation Filtrate - Phosphorus Removal | $775,000 |
| Phosphorus Filtrate Pump Station | $234,000 |
| UV Disinfection Building | $656,000 |
| Yard Piping Improvements | $439,000 |
| Site Improvements | $176,000 |
| Headworks | $706,000 |
| RAS/WAS Pump Station | $594,000 |
| Laboratory and Administration/Control Building | $1,355,000 |
| Electrical | $1,840,000 |
| Laboratory Testing Services | $100,000 |
| Subtotal | $17,275,000 |
| | |
| Other Support Facilities: | |
| Building in lieu of Canopy | $620,000 |
| Demolition | $1,441,000 |
| Subtotal | $2,061,000 |
| | |
| Subtotal of New Facilities | $19,336,000 |
| Construction Contingencies @ 10% | $1,934,000 |
| Subtotal | $21,270,000 |
| | |
| NMGRT @ 7.6875% | $1,635,000 |
| Total Construction Costs | $22,905,000 |
| | |
| **Professional Engineering Services Allowance @ 9.5%** | |
| Basic design services and allowance for special services including construction inspection (18 months), soils investigation, surveys, aerial mapping, operation and maintanance manual, and startup services | $2,176,000 |
| | |
| NMGRT @ 6.75% | $147,000 |
| Total Professional Engineering Services | $2,323,000 |
| | |
| **Total Project Costs** | $25,228,000 |

## TABLE 5-6
## ALTERNATIVE 2 CONCEPTUAL O&M COST

| ITEM | UNIT | QUANT | UNIT PRICE ($/kWh) | COST ESTIMATE ($/yr) |
|---|---|---|---|---|
| Influent Pumps | kWh/d | 725.28 | $0.08 | $21,193 |
| Bar Screen | kWh/d | 11.4 | $0.08 | $333 |
| Screenings Conveyor/Compactor | kWh/d | 15.05 | $0.08 | $440 |
| Grit Classifier | kWh/d | 7.6 | $0.08 | $222 |
| Grit Lift Pumps | kWh/d | 30.43 | $0.08 | $889 |
| Aerated Grit Blowers | kWh/d | 204.11 | $0.08 | $5,964 |
| Anaerobic Selector Mixers | kWh/d | 91.2 | $0.08 | $2,665 |
| Anoxic Selector Mixers | kWh/d | 0 | $0.08 | $0 |
| Aeration Basin Blowers | kWh/d | 4637.58 | $0.08 | $135,510 |
| Final Clarifiers | kWh/d | 12 | $0.08 | $351 |
| UV Units | kWh/d | 1440 | $0.08 | $42,077 |
| Aerobic Digester Blowers | kWh/d | 2341.84 | $0.08 | $68,429 |
| Returns Rapid Mixer | kWh/d | 115.2 | $0.08 | $3,366 |
| Returns Flocculator | kWh/d | 15.12 | $0.08 | $442 |
| Returns Clarifiers | kWh/d | 12 | $0.08 | $351 |
| RAS Pumps | kWh/d | 544.28 | $0.08 | $15,904 |
| Scum Pumps | kWh/d | 60.88 | $0.08 | $1,779 |
| WAS Pumps | kWh/d | 14.21 | $0.08 | $415 |
| Thickened Sludge Pump | kWh/d | 2.56 | $0.08 | $75 |
| Digested Sludge Pump | kWh/d | 4.57 | $0.08 | $134 |
| Alum Sludge Pump | kWh/d | 9.89 | $0.08 | $289 |
| Returns Pump | kWh/d | 29.05 | $0.08 | $849 |
| Chemical Feed Pumps | kWh/d | 24 | $0.08 | $701 |
| Belt Thickener | kWh/d | 40 | $0.08 | $1,169 |
| Belt Press | kWh/d | 31 | $0.08 | $906 |

| | | |
|---|---|---|
| Subtotal System Operation | $ | 304,450 |
| Subtotal System Maintenance (Estimate 1% of capital cost) | $ | 252,280 |

| | | |
|---|---|---|
| TOTAL ($/yr) | $ | 557,000 |
| Present Worth | $ | 8,288,000 |

**TABLE 5-7**
**ALTERNATIVE 3 CONCEPTUAL CAPITAL COST**

| **Construction Costs** | Amount |
|---|---|
| MBR Structure and Blowers/Canopy Structure/Alkalinity Augmentatioı | $10,476,000 |
| Influent Pump Station | $1,332,000 |
| Mechanical Dewatering Facilities | $1,776,000 |
| Aerobic Digester and Blower Structure | $1,227,000 |
| Chemical Precipitation Filtrate - Phosphorus Removal | $775,000 |
| Phosphorus Filtrate Pump Station | $234,000 |
| UV Disinfection Building | $656,000 |
| Yard Piping Improvements | $328,000 |
| Site Improvements | $176,000 |
| Headworks | $765,000 |
| RAS/WAS Pump Station | $594,000 |
| Laboratory and Administration/Control Building | $1,355,000 |
| Electrical | $2,560,000 |
| Laboratory Testing Services | $100,000 |
| Subtotal | $22,354,000 |
| | |
| Other Support Facilities: | |
| Demolition | $1,441,000 |
| Subtotal of New Facilities | $23,795,000 |
| | |
| Construction Contingencies @ 10% | $2,380,000 |
| Subtotal | $26,175,000 |
| | |
| NMGRT @ 7.6875% | $2,012,000 |
| Total Construction Costs | $28,187,000 |
| | |
| **Professional Engineering Services Allowance @ 9.0%** | |
| Basic design services and allowance for special services including construction inspection (18 months), soils investigation, surveys, aerial mapping, operation and maintanance manual, and startup services | $2,537,000 |
| | |
| NMGRT @ 6.75% | $171,000 |
| Total Professional Engineering Services | $2,708,000 |
| | |
| **Total Project Costs** | $30,895,000 |

## TABLE 5-8
## ALTERNATIVE 3 CONCEPTUAL O&M COST

| ITEM | UNIT | QUANT | UNIT PRICE ($/kWh) | COST ESTIMATE ($/yr) |
|---|---|---|---|---|
| Influent Pumps | kWh/d | 725.28 | $0.08 | $21,193 |
| Bar Screen | kWh/d | 11.4 | $0.08 | $333 |
| Screenings Conveyor/Compactor | kWh/d | 15.05 | $0.08 | $440 |
| Grit Classifier | kWh/d | 7.6 | $0.08 | $222 |
| Grit Lift Pumps | kWh/d | 30.43 | $0.08 | $889 |
| Aerated Grit Blowers | kWh/d | 204.11 | $0.08 | $5,964 |
| MBR System | kWh/d | 9834 | $0.08 | $287,349 |
| UV Units | kWh/d | 1440 | $0.08 | $42,077 |
| Aerobic Digester Blowers | kWh/d | 2341.84 | $0.08 | $68,429 |
| Returns Rapid Mixer | kWh/d | 115.2 | $0.08 | $3,366 |
| Returns Flocculator | kWh/d | 15.12 | $0.08 | $442 |
| Returns Clarifiers | kWh/d | 12 | $0.08 | $351 |
| RAS Pumps | kWh/d | 544.28 | $0.08 | $15,904 |
| Scum Pumps | kWh/d | 60.88 | $0.08 | $1,779 |
| WAS Pumps | kWh/d | 14.21 | $0.08 | $415 |
| Thickened Sludge Pump | kWh/d | 2.56 | $0.08 | $75 |
| Digested Sludge Pump | kWh/d | 4.57 | $0.08 | $134 |
| Alum Sludge Pump | kWh/d | 9.89 | $0.08 | $289 |
| Returns Pump | kWh/d | 29.05 | $0.08 | $849 |
| Chemical Feed Pumps | kWh/d | 24 | $0.08 | $701 |
| Belt Thickener | kWh/d | 40 | $0.08 | $1,169 |
| Belt Press | kWh/d | 31 | $0.08 | $906 |

| | | |
|---|---|---|
| Subtotal System Operation | $ | 453,274 |
| Subtotal System Maintenance (Estimate 1% of capital cost) | $ | 308,950 |
| Cartridge Replacement over Life cycle | $ | 1,200,000 |
| TOTAL ($/yr) | $ | 762,000 |
| Present Worth | $ | 12,539,000 |

Table 5-9 summarizes the capital and operating costs for each alternative, combining both into a present worth of cost.

**TABLE 5-9**

**ALTERNATIVE COST SUMMARY**

| Alternative | Capital Cost | Operating Cost ($/yr) | Present Worth |
|---|---|---|---|
| 1 | $25,897,000 | $585,000 | $34,602,000 |
| 2 | $25,228,000 | $557,000 | $33,516,000 |
| 3 | $30,895,000 | $762,000 | $43,434,000 |

*Includes a life-cycle cost of roughly $1.2 million for cartridge replacement

The present worth of cost is a combination of capital and operating cost, presented as an overall capital cost. Using interest rates as well as the salvage value of the equipment at the end of its projected service life, operating costs are translated to an equivalent lump sum that is combined with the capital cost to yield the present worth.

Alternatives 1 and 2

Alternatives 1 and 2 are similar in capital and operating costs. The costs have been estimated using a level of detail commensurate with that required for a *preliminary* design report, so they are not as accurate as an estimate that would be done during design. Hence, the costs for Alternatives 1 and 2 are essentially the same. The costs are high, but reasonable for a plant of which such high standards are required. Each cost is far more reasonable than that required for Alternative 3, so each alternative receives a ranking of 1.

Alternative 3

The capital cost of Alternative 3 exceeds that of the others by roughly 8-million dollars, and the Phase I present worth of Alternative 3 exceeds that of the others by roughly 10 million. For cost, Alternative 3 is receives an unfavorable rating of 3. However, the cost of membrane Gioreactors may decrease before the start of preliminary design, and Alternative 3 will be re-evaluated at that time.

### 5.5.7 Summary of Alternative Comparison

This section presents the three alternatives set aside for detailed consideration. The alternatives are compared with respect to the criteria established in Section 5.1. The rankings are summed, and a lower ranking indicates a more favorable alternative. Table 5-10 shows this summation.

**TABLE 5-10**

**ALTERNATIVE COMPARISON**

| **Criterion** | **Alt 1** | **Alt 2** | **Alt 3** |
|---|---|---|---|
| Regulatory Compliance | 1 | 1 | 1 |
| Expandability | 2 | 2 | 1 |
| Site Efficiency and Constructability | 2 | 2 | 1 |
| Operation and Maintenance | 1 | 1 | 3 |
| Public Acceptance | 2 | 2 | 2 |
| Cost Considerations | 1 | 1 | 3 |
| **Sum** | **9** | **9** | **11** |

Alternative 3 costs up to ten million more in life cycle costs over the other alternatives, and the operation and maintenance of the MBR process are more difficult. It is preferable for site efficiency, expandability, and constructability because it doesn't use primary clarifiers, but these advantages do not justify the substantially higher cost and operational difficulty. However, the cost of MBRs may go down before the preliminary design phase, and MBRs may become cost competitive at that time. MBRs will be re-evaluated before the start of preliminary design.

Alternatives 1 and 2 are ranked equally, and there is not sufficient cause for elimination of either alternative. Moreover, the alternatives are identical apart from operation of the treatment basins.

Alternative 2 may allow for the use of smaller basins, but this is not certain, and such a determination can only be made after detailed analysis that is beyond the scope of this report. In general, the point can be made that reduction of organics and ammonia with the activated sludge process must require a given basin size for a given flow rate with a given contaminant strength.

Variations in process operation can change the volume requirement slightly, but it is unlikely that the basin sizes for Alternatives 1 and 2 would be substantially different. Moreover, it is suggested that basin size should not be a significant factor in choosing an alternative. Cost, operability, and maintainability are paramount, and both alternatives are nearly indistinguishable in this regard.

Alternatives 1 and 2 differ mainly in their modes of operation, and as such, the decision between them depends largely on the preferences of the plant operators and the Joint Use Board. A decision between them should be made during preliminary design, based on consultation between the engineer, the Joint Use Board, and the WWTP staff.

## 5.6 References


1. Wastewater Facilities Plan, Molzen-Corbin & Associates, 1993.
2. New Mexico Environment Department (NMED) Standards.
3. Manufacturer's recommendations.
4. Environmental Protection Agency, Nitrogen Control, 1993.
5. Metcalf & Eddy, Wastewater Engineering, 4th Ed., 2003.
6. Texas Commission on Environmental Quality (TCEQ) Standards.
7. Water and Environment Federation, Design of Municipal Wastewater Treatment Plants, 1992.

## 6.0 PROPOSED PROJECT

Section 5 provided a list of alternatives, narrowing the list down to three alternatives, which were considered in detail. After comparison using specific design criteria, it was determined that two of the alternatives were equally worthy of consideration, and that the choice between them should be made during preliminary design, based on consultation between the engineer, the Joint Use Board, and the WWTP staff.

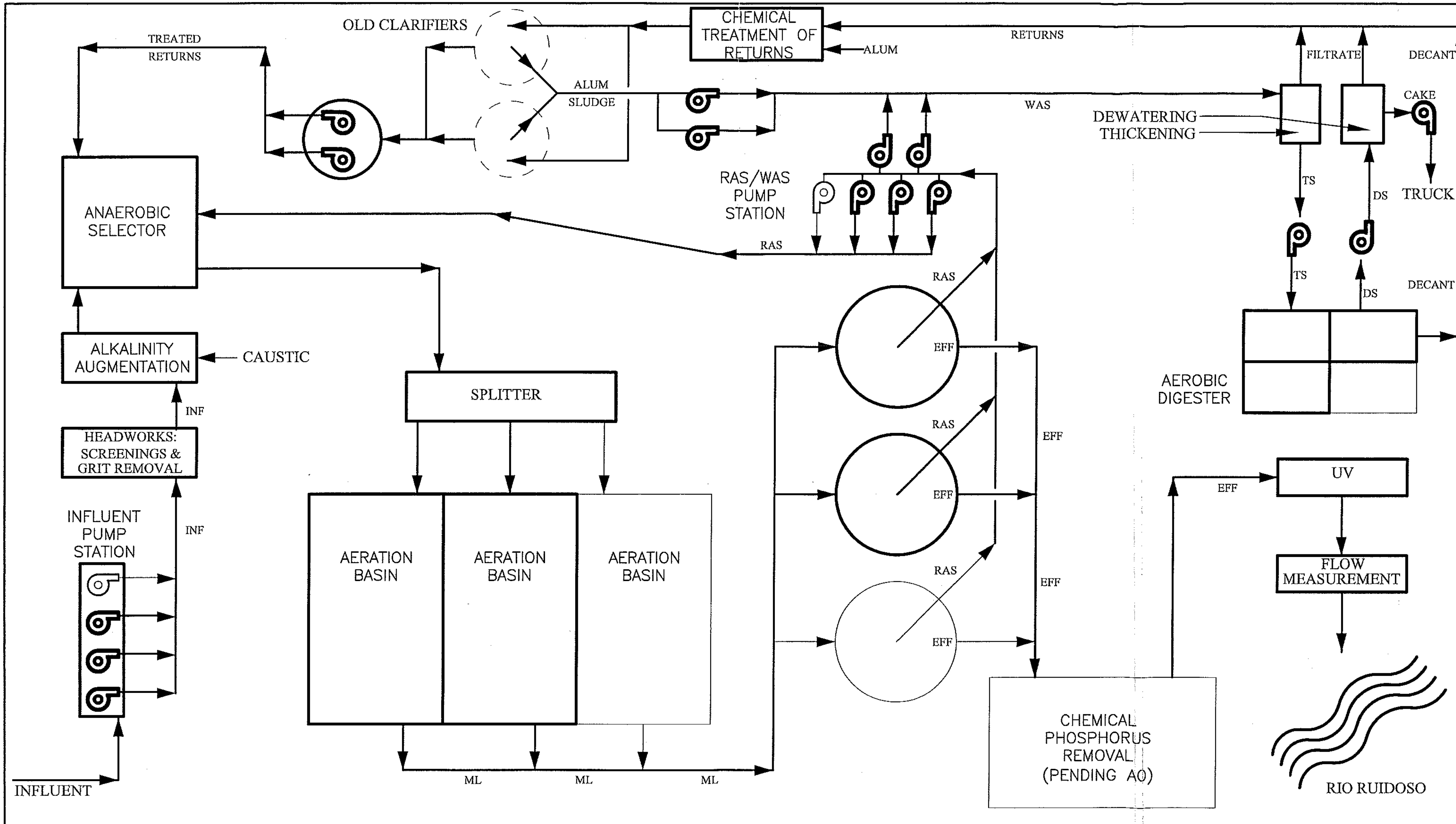
The two alternatives selected in Section 5 are identical in all regards other than the design of the aeration basins. Alternative 1 recommends that each aeration basin use a conventional BNR process. Alternative 2 recommends that each aeration basin be designed based on simultaneous nitrification and denitrification. In all other regards, the two alternatives are identical. Each alternative recommends identical treatment modules before and after the aeration basins, and each alternative recommends two parallel aeration basins for Phase I and an additional parallel aeration basin for Phase II.

### 6.1 Project Summary

In Section 5, and on the basis of information presented in Sections 3 and 4, it was recommended to replace the existing treatment plant with a modern plant employing biological removal of BOD, phosphorus, ammonia, and nitrate. Figure 6-1 presents a summary of the proposed process, which is described herein. Appendix C contains the calculations used to for approximate sizing of the various unit processes.

#### 6.1.1 Design Basis

As described in Sections 3, 4 and 5, the Ruidoso WWTP must accommodate an expanding population and new effluent regulations, particularly those on effluent phosphorus and whole effluent toxicity (WET). Because the existing plant has insufficient capacity and is not designed for BNR, a larger BNR plant must replace it.

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ENGINEERS/ARCHITECTS/PLANNERS

FUTURE

PROPOSED

EXISTING

Ruidoso-Ruidoso Downs Regional WWTP Joint Use Board

Figure 6-1
Schematic of Proposed Project

During the chosen planning period starting in 2005 and ending in 2030, Section 4 projects that plant influent will increase to 3.75 mgd. The plant currently accepts an average daily influent of roughly 1.4 mgd. The length of the planning period and the degree of plant expansion call for a two-phase expansion, with Phase I to be implemented as soon as possible, and Phase II to be implemented when necessary. Phase I expands the capacity to 2.5 mgd. Phase II will expand the capacity to 3.75 mgd.

Ruidoso sought to raise the effluent phosphorus limit from 0.1 mg/l to 1.0 mg/l through implementation of a "Water Quality Trading Program." However, after exploring such a program with a consultant, Ruidoso determined that the program would not be feasible. Because Ruidoso is now committed to constructing and operating a plant capable of meeting the 0.1 mg/l effluent phosphorus limit, the discussion in this Section 6.1.1 concerning the impact of a 0.1 mg/l versus a 1.0 mg/l limit is presented only as background information. Each effluent standard requires a different approach to chemical phosphorus removal.

- If the effluent phosphorus limit is raised to 1 mg/l, a small chemical precipitation system is installed for removal of phosphorus from the plant returns, which consist of digester decant, belt thickener filtrate, and belt press filtrate. This is done to enhance the biological phosphorus removal system presented for all three alternatives, ensuring that the plant consistently meets the 1 mg/l standard. Figure 5-4 summarizes this system.
- If the effluent phosphorus limit remains at 0.1 mg/l, an independent, tertiary chemical process is installed downstream of the activated sludge process. This chemical phosphorus removal system treats the entire plant throughput, reducing effluent phosphorus to 0.1 mg/l or less. Return flows are routed to the head of the chemical system, and not to the head of the plant, so the return flows are not treated separately, as they would be for an effluent standard of 1 mg/l. Figure 5-5 summarizes this system.

For ease of comparison, the cost estimate for the proposed plant is based on an effluent phosphorus limit of 1 mg/l, meaning the cost estimate includes the cost of a system for chemical treatment of returns. The added cost of reducing effluent phosphorus to 0.1 mg/l is also presented.

Table 6-1 summarizes the plant design basis with respect to hydraulic, organic, and nutrient loadings.

**TABLE 6-1**

**PROCESS DESIGN BASIS**

| | **Influent** | **Effluent** |
|---|---|---|
| Phase I Design Flow (mgd) | 2.5 | 2.5 |
| Phase I Two-Hour Peak Flow (mgd) | 6.5 | N/A |
| Phase II Design Flow (mgd) | 3.75 | 3.75 |
| Phase II Two-Hour Peak Flow (mgd) | 9.75 | N/A |
| T (min/max) $^{o}$C | 10 / 21 | N/A |
| BOD5 (mg/l) | 325 | $\leq 30$ |
| TSS (mg/l) | 362 | $\leq 30$ |
| VSS (mg/l) | 307 | N/A |
| TKN (mg/l) | 50 | $\leq 1$ |
| Ammonia Nitrogen (mg/l) | 30 | $\leq 1$ |
| Nitrate Nitrogen (mg/l) | 0 | $\leq 5$ |
| Total P (mg/l) | 8 | $\leq 0.1$ |
| pH | 7.1 | N/A |
| Alkalinity (mg/l) | 270 | N/A |

Note that the BOD and TSS concentrations are more concentrated that that of the wastewater currently loaded to the plant. This is due to anticipated future efforts to conserve water, as well as the possibility of higher commercial growth.

6.1.2 Alkalinity Augmentation

The combined concentrations of organic nitrogen and ammonia in water is called the Total Kjeldahl Nitrogen (TKN), which is oxidized to nitrate in the aerobic portion of a BNR process. Every part of TKN oxidized requires 7.14 parts alkalinity, but denitrification reduces this requirement by roughly half. Hence, every milligram of influent TKN requires roughly 3.6 mg of alkalinity. The design influent must therefore have 144 mg/L alkalinity.

Every mg of dosed alum requires 4.5 mg of alkalinity. The worst-case dose of alum, to the entire plant throughput, is 80 mg/L, which requires 320 mg/L of alkalinity.

The lowest alkalinity reading recently taken from the plant influent was 270 ppm. It is conservatively assumed that this concentration will not change over time, even as other wastewater constituents become more concentrated due to increased use of water saving fixtures. Hence, it must be verified that this influent alkalinity is sufficient to sustain the proposed process, which consumes alkalinity. If the influent alkalinity is not high enough, alkalinity augmentation is necessary.

Using the process design basis of Table 5-2, and accounting for nitrogen that is fixed into the biomass and/or lost in the waste sludge, the nitrification step of the BNR process consumes roughly 273 ppm of alkalinity. The denitrification step restores roughly 118 ppm, leaving an operating alkalinity of 116 ppm in the mixed liquor. This is well above the 50 mg/l necessary to prevent a drop in nitrification rate. Hence, the influent alkalinity is sufficient to sustain the proposed BNR process.

Each feasible alternative recommends an independent, tertiary chemical treatment process downstream of the BNR process. This chemical phosphorus removal system will dose the entire plant throughput with alum, which consumes alkalinity. The anticipated alum dose is 80 ppm, which consumes 36 ppm of alkalinity. This process would reduce the alkalinity of the BNR effluent to 44 ppm, which is sufficient to sustain alum coagulation. Hence, the BNR effluent has sufficient alkalinity to sustain a tertiary chemical treatment process, if the latter becomes necessary. In theory, a tertiary chemical treatment process would not make alkalinity augmentation necessary.

Although it is unlikely that augmentation will be necessary, the following scenarios may make it necessary.

- A plant upset may reduce the rate of denitrification, which restores the alkalinity consumed by nitrification.
- The tertiary alum dose may be higher than 80 ppb.

- Alum may be dosed to the BNR process as well as the tertiary process.
- An iron-based coagulant may be used in lieu of alum. Iron coagulants consume more alkalinity.
- The influent nitrogen concentration may increase beyond the conservative projections herein.
- The influent alkalinity may decrease to below its measured levels.

To account for these possibilities, an alkalinity augmentation system should be seriously considered during the preliminary design phase. The system should be capable of feeding to the headworks and to the head of the tertiary chemical treatment system, if the latter becomes necessary. Prior to the design phase, additional alkalinity readings should be taken to ensure that the plant influent alkalinity is consistent.

The alkalinity augmentation system should be based on soda ash, and not on caustic solution, which is too expensive. A modest alkalinity augmentation of 20 mg/l, if done continuously with caustic solution, would cost up to $488,000 per year at Phase I flow. Soda ash can supply the same dose for as little as $81,000 per year.

Neither of the above costs is included in the operating cost estimates of Section 6, because it is anticipated that alkalinity augmentation will not be necessary. It is only recommended to have an augmentation system on stand-by, in case it is needed due to a plant upset, a change in the process, or a change in wastewater constituents.

### 6.1.3 Influent and RAS Pump Replacement

The influent and RAS lift stations are demolished, along with their structures and buildings.

A new submersible influent pumping station is constructed at the head of the plant. The basin is sized for Phase II flow, though the pumping capacity is sufficient only for Phase I.

New RAS and WAS pumps are installed adjacent to the secondary clarifiers. The RAS pump station is initially sized for Phase I and expanded for Phase II. The WAS pump station is the same size for Phases I and II.

### 6.1.4 Replacement of Headworks

The new screening process handles existing flow without allowing too small a channel velocity, and it handles Phase II flow without allowing too high an intra-bar velocity. This is accomplished with a three-channel structure. For Phase I, a channel is blocked off using slide gates. A mechanical screen is installed in one channel, and a manual bypass screen is installed in the third channel. The bars have 1/4$^{th}$-inch spaces between. For Phase II, the previously blocked channel is opened and fitted with a second mechanical screen.

The screening channels are roughly 2.5 feet wide and four feet deep. The parallel channels rest atop a concrete room that houses the grit pumps, which sit on a floor that matches grade.

The proposed grit chamber uses the existing grit classifier, and a new basin with a bypass. The basin is buried just deeply enough to eliminate the need for structural supports, and it is connected to the pump room that supports the screening channels. The grit chamber, screening channels, and pump room form a single structure that sits on the highest available ground.

### 6.1.5 Anaerobic Selection

An anaerobic selector is built downstream of the headworks and upstream of a proposed new splitter box. The anaerobic selector is a serpentine contact basin designed for a hydraulic residence time (HRT) of 1.5 hours at Phase II flow, resulting in an HRT of 2.25 hours for Phase I.

The volume of the proposed anaerobic selector is roughly 240,000 gallons. The basin length, width, and sidewater depth are 58 feet, 31 feet, and 22 feet, respectively. The basin allows two feet of freeboard. The basin has four passes, with the first being used to remove dissolved oxygen and nitrate from the RAS. Headworks effluent is introduced at the start of the second pass. Each pass is equipped with a 3-hp mixer aimed opposite the direction of flow.

#### 6.1.6 Aeration

After the anaerobic selector, flow splits equally into two parallel aeration basins. Each basin is designed for 1.25 mgd average daily flow, and a third identical basin will be added for Phase II.

As stated in Section 5.5.8, two alternatives are considered for the proposed project, and they differ regarding the operation of the aeration basins. Alternative 1 proposes a conventional BNR process, equipping each aeration basin with a pre-anoxic zone, aerobic zone, and an anoxic recycle stream. Alternative 2 proposes an SNdN process, which carries out ammonification, nitrification, and denitrification in the same basin. In Section 5.5.8, neither alternative was eliminated, because the two alternatives are similar regarding cost, operation, maintenance, and other evaluation criteria stated in Section 5. A decision between the two alternatives should be made during preliminary design, based on consultation between the Engineer, the Joint Use Board, and the WWTP staff.

#### 6.1.7 Clarifiers

Flow is split equally into two clarifiers, and a third clarifier will be added for Phase II. The clarifiers concentrate the biomass and return it to the anaerobic selector. Treated water flows over the clarifier weirs to the disinfection process.

The clarifiers are 80 feet in diameter with 16 feet sidewater depth. The clarifiers are centrally driven, in contrast to the peripheral drives on the existing clarifiers, which are problematic due to snow buildup on the sidewalls. Phase I uses two clarifiers, and a third will be installed for Phase II.

The proposed clarifiers have flat bottoms and are designed to have no sludge blanket. This minimizes the residence time of the biomass in the clarifier, ensuring that the bacteria remain healthy.

### 6.1.8 UV Disinfection

For reasons described in Section 3, the existing chlorination/dechlorination system is replaced with UV disinfection. The existing chlorine contact tank is demolished to below ground level, and the remainder is filled in. A new UV Building is erected at grade and just east of the existing chlorine contact chamber. A single secondary effluent pipe enters the building and splits into two branches, each with an in-line UV disinfection unit that looks similar to a mixing tee. Each is designed for all plant throughput, so that one can be used for a standby. For Phase II, the units will be removed and replaced with more powerful units.

### 6.1.9 Mechanical Belt Thickening

The gravity thickener is replaced with a 2-meter mechanical belt thickener. WAS is pumped to the belt and thickened to 5 percent, before passing onto the aerobic digester.

The proposed two-meter belt thickener handles 400 gpm of flow, and it must handle about this amount of flow regardless of the actual amount of sludge to be wasted. Hence, the amount of sludge to be wasted determines the amount of time spent wasting and thickening the sludge.

For determination of sludge application rates, it is assumed that the secondary clarifier effluent is dosed with 80 mg/l of alum and then routed to tertiary clarifiers. The alum sludge produced is such that eight percent of the total applied sludge is alum sludge.

For Phase I, the sludge application rate is roughly 5,700 lb/d dry solids, or 58 gpm. Assuming a 5-day workweek, the thickener requires operation for five hours per day.

For Phase II, the sludge application rate will be roughly 8,530 lb/d dry solids, or 90 gpm. Assuming a five day workweek, the thickener will require operation for roughly seven hours per day.

For both phases, the belt thickener captures roughly 98 percent of the sludge, and the thickened concentration is roughly 5 percent solids.

### 6.1.10 Aerobic Digestion

It is assumed that the plant will continue composting dewatered sludge and measuring their finished sludge for pathogen levels. Hence, it is not necessary for the aerobic digester to meet the requirements of 40 CFR 503 for pathogen reduction. The digester is designed to reduce vector attraction, assuming a basin water temperature of 15 C. For this, it is necessary to reduce volatile solids by 38 percent, which in turn requires a 28-day SRT.

For Phase I, the basin volume required for a 28-day SRT is 335,000 gallons, assuming a feed sludge concentration of 5 percent. For Phase II, this volume increases to 502,000 gallons.

The proposed Phase I digester is a three-compartment structure, consisting of a center square compartment with additional square compartments on the south and east sides. In plan view, as shown on the schematics, the three compartments make up 3/4ths of a square structure. The fourth part will be added for Phase II. Each compartment has an interior dimension of 28 feet by 28 feet, with a 22-foot sidewater depth and 2 feet of freeboard. The same compartment is always used for drawdown and decant, so the other compartments can continue operating. One compartment may be used for denitrification of nitrate produced during digestion.

The structure is installed above ground, which is easily possible since positive-displacement pumps feed the digester and draw from it. The high water surface also aids in the drainage of decant to the plant returns system.

### 6.1.11 Mechanical Dewatering

A positive-displacement pump draws sludge from the digester and feeds it at roughly 150 gpm to a proposed belt press. Since the compartment used for wasting can be settled and decanted prior to wasting, without stopping digestion altogether, it is assumed that the digested sludge has the same concentration as the sludge fed to the digester. In reality, the digested sludge may be more concentrated than the feed sludge, but for design, it is most prudent to assume that the digested sludge has the same concentration as the belt-thickened sludge, or roughly 5 percent.

The proposed two-meter belt press handles 1,600 lb/h of digested sludge, on a dry-solids basis. It must handle about this flowrate regardless of the actual mass of sludge to be dewatered. Hence, the amount of sludge to be dewatered determines the amount of time spent running the press.

For determination of sludge application rates, it is assumed that the secondary clarifier effluent is dosed with 80 mg/l of alum and then routed to tertiary clarifiers. The alum sludge produced is such that eight percent of the total applied sludge is alum sludge.

For Phase I, the digester wasting rate is roughly 3,900 lb/d dry solids. Assuming a 5-day workweek, the belt press requires operation for 3.5 hours per day.

For Phase II, the digester wasting rate will be roughly 6,200 lb/d dry solids. Assuming a five day workweek, the belt press will require operation for roughly 5.5 hours per day.

For both phases, the belt press captures roughly 98 percent of the sludge, and the thickened concentration is roughly 19 percent solids.

### 6.1.12 Finished Sludge Processing

A new building is erected to house the belt thickener and belt press. This building is to be located east of the Administration Building and be equipped with a truck-loading canopy or bay.

### 6.1.13 Chemical Phosphorus Removal

Ruidoso sought to raise the effluent phosphorus limit from 0.1 mg/l to 1.0 mg/l through implementation of a "Water Quality Trading Program." However, after exploring such a program with a consultant, Ruidoso determined that the program would not be feasible. Because Ruidoso is now committed to constructing and operating a plant capable of meeting the 0.1 mg/l effluent phosphorus limit, the discussion in this Section 6.1.13 concerning the impact of a 0.1 mg/l versus a 1.0 mg/l limit is presented only as background information. Each effluent standard requires a different approach to chemical phosphorus removal.

- If the effluent phosphorus limit is raised to 1 mg/l, a small chemical precipitation system is installed for removal of phosphorus from the plant returns, which consist of digester decant, belt thickener filtrate, and belt press filtrate. This is done to enhance the biological phosphorus removal system, ensuring that the plant consistently meets the 1 mg/l standard. Figure 5-4 summarizes this system.
- If the effluent phosphorus limit remains at 0.1 mg/l, an independent, tertiary chemical process is installed downstream of the activated sludge process. This chemical phosphorus removal system treats the entire plant throughput, reducing effluent phosphorus to 0.1 mg/l or less. Return flows are routed to the head of the chemical system, and not to the head of the plant, so the return flows are not treated separately, as they would be for an effluent standard of 1 mg/l. Figure 5-5 summarizes this system.

#### Effluent Limit of 1 mg/l

Compliance with an effluent limit of 1 mg/l is achieved mainly with an anaerobic selector. Phosphorus in the return flow may overwhelm the anaerobic selector and compromise the ability of the plant to maintain a discharge standard of 1 mg/l, so a small chemical treatment system removes phosphorus from the plant return flows.

As shown in Figure 5-4, the return flows drain to a modular system consisting of a rapid mix basin with alum feed, and a flocculation basin. The flow drains to the existing secondary clarifiers, which are converted for use in chemical precipitation. Clarifier overflow is pumped to the anaerobic selector using a new duplex pump station. The alum sludge is combined with the waste activated sludge and sent for processing. The alum sludge constitutes an insignificant portion of the total sludge mass.

To convert the existing clarifiers for use in chemical precipitation, it is necessary to replace the drive units and repair the concrete atop the sidewalls, which has been corroded by salt used for snow removal. The new drives are driven from the center.

The chemical treatment module, as well as the existing secondary clarifiers, are adequate for chemical precipitation of Phase I and Phase II return flows.

Effluent Limit of 0.1 mg/l

For an effluent limit of 0.1 mg/l, chemical treatment of the entire plant throughput is required. This is accomplished with an independent, tertiary chemical precipitation system, as shown in Figure 5-5. Plant returns are not treated separately, and are instead routed to the head of the chemical precipitation process, and not to the head of the plant.

- MBRs may facilitate the addition of chemical phosphorus removal to the activated sludge process itself, thereby avoiding the need for a tertiary process.
- Although MBRs are expensive, because the technology is new, the price may go down before preliminary design is started.

As shown in Figure 5-5, the secondary clarifier overflow drains to a modular system consisting of a rapid mix basin with alum and polymer feed, and a flocculation basin. The basins are adequate for Phase I and Phase II plant flows.

The flow drains to new tertiary clarifiers, each roughly 80 feet in diameter. Two are required for Phase I flow, and a third is required for Phase II flow.

In lieu of clarifiers, the flocculator effluent may be filtered directly. This will be evaluated further during preliminary design.

Clarifier overflow drains to the disinfection system. Some of the alum sludge is recovered and reused. The remaining alum sludge is combined with the waste activated sludge and sent for processing. The alum sludge constitutes about eight percent of the total sludge mass.

Determination of Chemical Treatment Requirements

The proposed plant allows for the installation of either a returns treatment system or a throughput treatment system. The plant has room for a throughput treatment system, which can be placed between secondary treatment and disinfection. The sludge presses and digester can accept the alum sludge that throughput chemical treatment would generate. The plant has at least 14 feet of spare hydraulic head, which can drive the throughput through a chemical treatment process without pumping.

6.1.14 Upgrade of Plant Controls

The proposed process is too complex to be managed by the existing control system at the plant. For management of the new system, it is necessary to install a new *distributed control system*, or DCS. This consists of a network of PLCs connected to a central PLC, which is connected to a man-machine interface, or a computer that operators use to control and monitor the plant via the DCS. Some plant unit processes are controlled by vendor-supplied PLCs, and some other unit processes are controlled directly by the central PLC.

### 6.1.15 Administration and Controls Buildings

A new Administration Building and a new Controls Building are constructed. Both are located close to the existing O&M Building. The new Administration Building avoids the need for modifications to the existing building, which would require bringing the existing building into compliance with all codes.

The new building should have a women's washroom, new laboratory, and a new control station.

### 6.1.16 Treatment Plant and Discharge Location

Figure 3-1 shows the location of the Ruidoso WWTP. The outfall is located precisely at Lattitude 33° 21' 38" N, Longitude 105°, 32' 35" W.

### 6.1.17 Collection System

This report does not recommend any changes to the existing sewage collection system for Ruidoso. It is assumed that this system is adequate for present and future flows.

## 6.2 Hydraulic Calculations

This section develops a preliminary hydraulic profile of the plant to verify that the site has sufficient elevation drop for gravity flow through the plant. Additionally, this profile estimates the spare hydraulic head available to supply a throughput chemical treatment system, if one becomes necessary.

### 6.2.1 Basis of Hydraulic Design

The hydraulic calculations are based on a conservative set of assumptions summarized in Table 6-2. These assumptions are used to calculate the water surface (ws) in each individual unit process. All elevations are based on mean sea level (MSL). Head losses (hl) are conservatively assumed based on past experience.

**TABLE 6-2**

**ASSUMPTIONS FOR PLANT HYDRAULIC CALCULATIONS**

| Item | Assumption |
|---|---|
| Grit Chamber ws | 6193 ft |
| Bar Screen hl | 12 in |
| Grit Chamber Baffle hl | 24 in |
| Weir hl | 6 in |
| Weir safety factor | 6 in |
| hl in pipe between units | 24 in |
| UV required w.s. | 6167 ft |

The grit chamber water surface is the starting point for calculating the hydraulic profile, which is unusual in that most hydraulic profiles start at the end of the plant. In this case, it was known that the plant had adequate elevation drop from start to finish, and it was necessary to determine the amount of spare hydraulic head that would be available for the possible installation of a chemical phosphorus removal system for the plant throughput. The effort was also made to maximize the hydraulic profile, thus reducing the bury depths of the deep basins.

The grit chamber water surface was determined according to a layout recommended to a prominent manufacturer of grit removal facilities. The proposed layout puts much of the grit basin above grade. A concrete pump room is installed next to the grit basin, and the screening channels rest atop the pump room, supported by the pump room concrete. By this layout, the water surface in the grit chamber is roughly 18 feet above grade. It is planned to use land adjacent to the existing gravity thickener. This grade has previously been finished to an elevation of 6175 ft, yielding a proposed grit chamber water surface of 6193 ft, as shown in Table 6-2.

The water surface required for the in-line UV units is an equivalent water surface that represents the water pressure required at the entrance to the units. This equivalent water surface accounts for the design features necessary to ensure that the in-line units are full at all times.

The "weir safety factor" named in Table 6-2 is the approximate height between the top of a weir and the water surface immediately downstream of the weir. This safety factor should be as listed in Table 6-2 at the 2-hour peak flow, thus ensuring that the plant won't experience a backup during periods of high flow.

### 6.2.2 Site Considerations

Reports indicate that the groundwater table is roughly 40 feet below the plant surface, which would put it at roughly the same elevation as the Rio Ruidoso. The groundwater table is likely to be at this elevation since groundwater in the vicinity of surface water tends to have same surface elevation as the surface water. Because the water table is so deep, it is a near certainty that no groundwater control is required for construction of the proposed project.

The Federal Emergency Management Agency (FEMA) has not determined a 100-year flood elevation for the plant site. An estimate of the 100-year flood elevation comes from the construction plans presented by Daniel Engineering for the original plant. According to this plan set, the flood plain ranges from 6135 ft MSL to 6148 ft MSL.

### 6.2.3 Preliminary Hydraulic Profile

Based on the assumptions and calculations presented in Appendix D and Section 6.2.1, the preliminary hydraulic profile is as shown in Table 6-3. Note, the water surface (ws) elevation given for the UV station is an equivalent water surface used to indicate the pressure within the units. The required equivalent water surface is 6167 ft MSL, which is necessary to get the water through the units and through the restrictions used to keep the units full. The profile presented in Table 6-3 presents the actual equivalent water surface. The difference between the actual and required water surfaces represents the spare hydraulic head that may be used to accommodate a chemical treatment system.

**TABLE 6-3**

**SUMMARY OF PLANT HYDRAULIC PROFILE**

| Unit | ws (ft MSL) |
|---|---|
| Screening | 6196 |
| Grit Removal | 6193 |
| Anaerobic Selector | 6190 |
| Aeration Basins | 6187 |
| Clarifiers | 6184 |
| UV Area | 6181 |

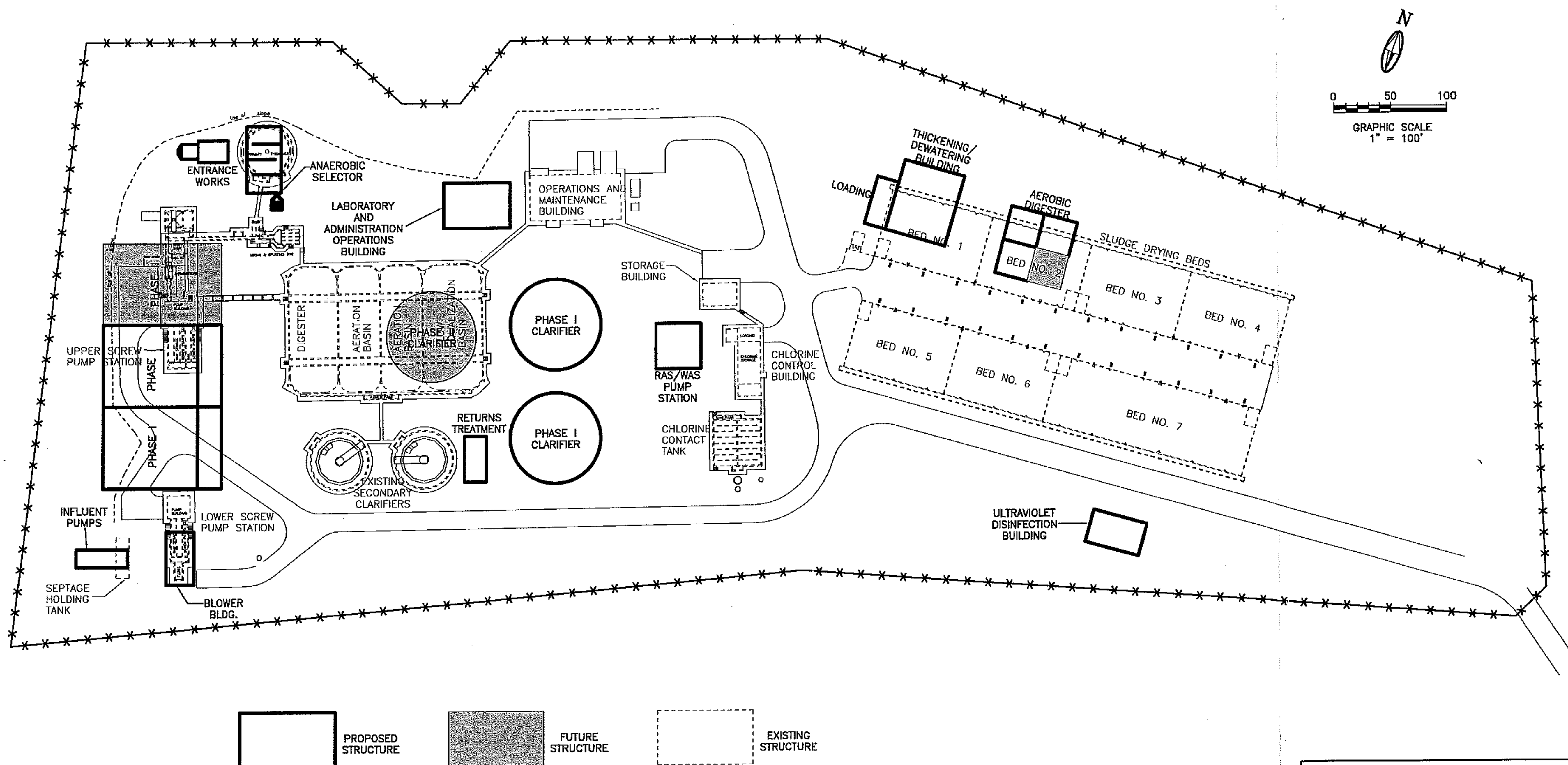
Natural grade ranges from 6175 ft MSL to 6160 ft MSL, so the basins are only partially buried. Note also that the equivalent water surface at the UV module exceeds that required by 14 feet, which is ample spare hydraulic head to pass water through a chemical treatment process, if one is installed.

No hydraulic profile is presented for the biosolids treatment processes, because none is necessary. Starting with the WAS pumps, all flow is pumped flow, and all pumps are positive-displacement pumps. The aerobic digester is simply set at grade.

## 6.3 Construction Staging vs. New Land Acquisition

It is not possible to build the proposed project in the free space available at the plant. It is necessary either to acquire new land or to stage construction. This is demonstrated in Figure 6-2, which shows a preliminary, conceptual layout of the proposed project compared to the layout of the existing plant. The proposed layout is only a possible layout, and the actual layout of the proposed project would be determined during the preliminary design phase, and after determination of the phosphorus effluent limit.

For construction of the proposed project, it is highly recommended that Ruidoso acquire additional land. A small amount of land, in combination with the space available on the existing plant site, would allow Ruidoso to build the entire project without disturbing the existing process, as shown in Figure 6-3. It would be sufficient to purchase a two-acre plot of land, extending roughly 150 feet to the west of the existing site.

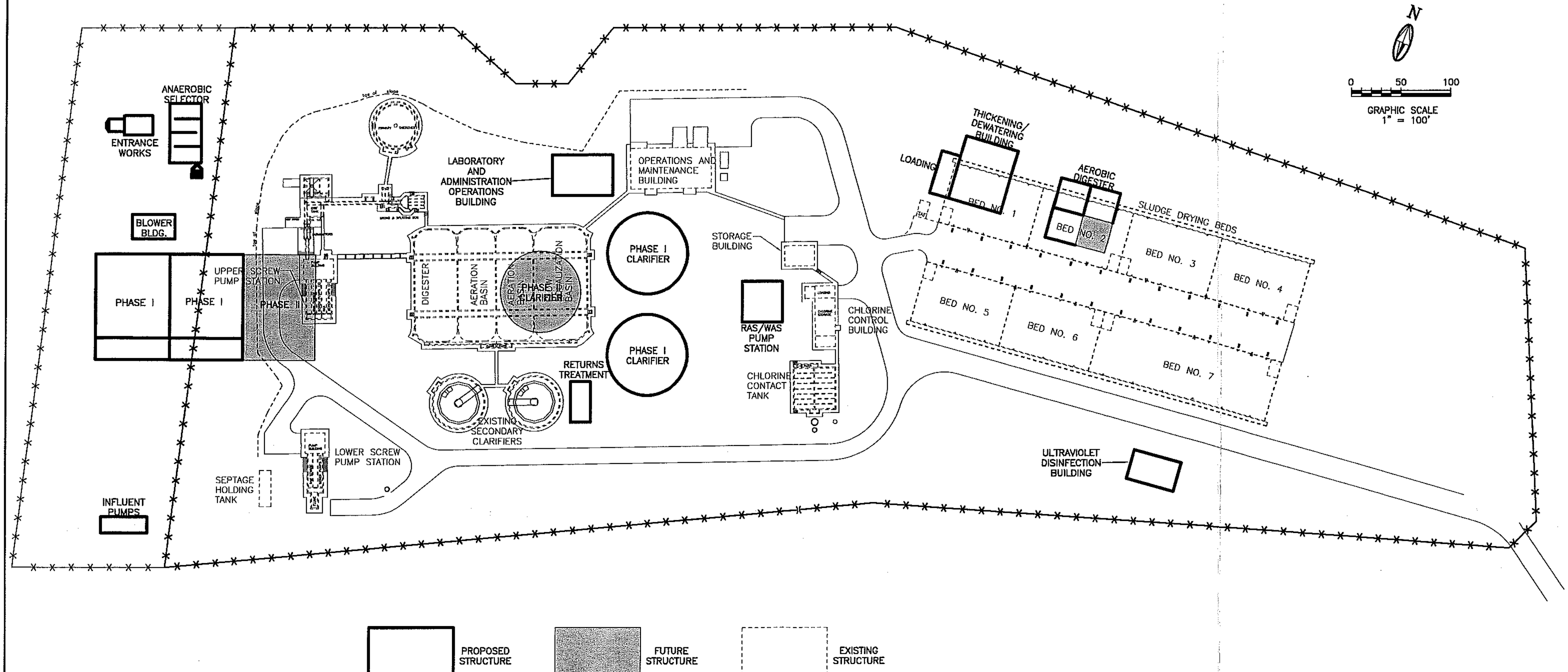



VILLAGE OF RUIDOSO NEW MEXICO

**FIGURE 6–2**

**CONCEPTUAL PLANT LAYOUT**

MOLZEN-CORBIN & Associates




VILLAGE OF RUIDOSO NEW MEXICO

# FIGURE 6–3

# CONCEPTUAL LAYOUT WITH NEW LAND

MOLZEN-CORBIN & Associates

By acquiring new land, Ruidoso would save a great deal of money on demolition costs, since abandoned modules would be demolished to ground level and covered with new ground.

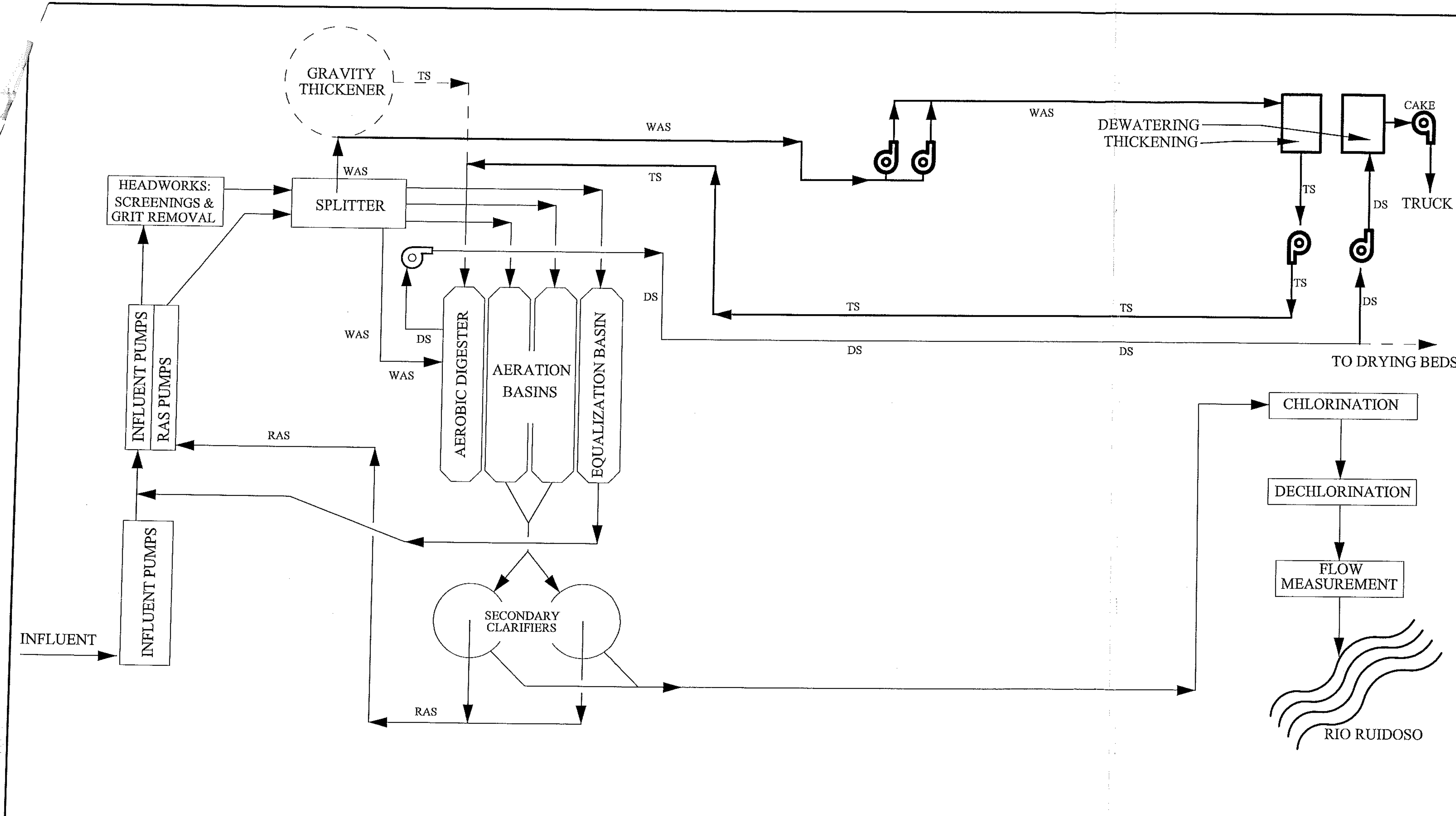
Unless new land is acquired, the plant will most likely require staged expansion, because the existing site has very little free space. Construction staging will cost more due to longer construction time and the greater amount of work necessary. It will also increase demolition costs, since some modules will require complete demolition, allowing new modules to be built in the previously occupied space.

## 6.4 Installation of Presses

Ruidoso has expressed an urgent need to install new biosolids handling equipment as soon as possible, because the existing drying beds are currently being overwhelmed. To this end, it is proposed to install the thickening and dewatering presses in a separate project, completed before the start of the other parts of the project. Figure 6-4 shows a possible schematic of how this might be accomplished.

For efficiency of construction, the thickening and dewatering presses are installed concurrently, along with the positive displacement pumps necessary to run the belts. The dewatering building and unloading station are erected as well.

WAS is pumped to the new belt thickener, and the thickened sludge is pumped back across the plant to the existing digester. With the existing digested sludge pump, digested sludge is pumped to the belt press, which thickens the sludge to roughly 19% TSS. The sludge is loaded to a truck, from which it can be composted by the windrow method on the existing sludge drying beds. Alternately, it can be removed and discarded by a method to be determined by Ruidoso.

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EXISTING PROPOSED DEMOLISH

Ruidoso-Ruidoso Downs Regional WWTP Joint Use Board

Figure 6-4
BELT ADDITION

## 6.5 Cost Estimate

Detailed cost estimates were done for Chapter 5 and are summarized here in Table 6-4.

**TABLE 6-4**

**SUMMARY OF PROJECT COSTS**

| Alternative | Capital Cost | Operating Cost ($/yr) | Present Worth |
|---|---|---|---|
| 1. Conventional BNR | $25,761,000 | $560,000 | $31,905,000 |
| 2. SNdN | $25,108,000 | $536,000 | $30,885,000 |

As stated in Section 5.5.8, two alternatives are considered for the proposed project, and they differ regarding the operation of the aeration basins. Alternative 1 proposes a conventional BNR process, equipping each aeration basin with a pre-anoxic zone, aerobic zone, and an anoxic recycle stream. Alternative 2 proposes an SNdN process, which carries out ammonification, nitrification, and denitrification in the same basin. In Section 5.5.8, neither alternative was eliminated because the two alternatives are similar regarding cost, operation, maintenance, and other evaluation criteria stated in Section 5.

Both are equally worthy of consideration, and that the choice between them should be made during preliminary design, based on consultation between the engineer, the Joint Use Board, and the WWTP staff.

## 6.6 Cost Estimate – Chemical Phosphorus Removal

The cost estimates of Table 6-4 are based on an effluent phosphorus limit of 1 mg/l. Hence, the estimates include a small chemical treatment system for removal of phosphorus from the plant returns. However, since the effluent phosphorus limit in effect is 0.1 mg/l, the costs of Table 6-4 increase substantially, because chemical treatment of the entire plant throughput is required. (Additional costs are shown in Table 6-5.)

## TABLE 6-5

## CONCEPTUAL COST FOR CHEMICAL PHOSPHORUS REMOVAL FROM 2.5 MGD

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **New Tertiary Rapid Mix Box (12x12x12)** | | | | |
| Concrete Walls | CY | 29 | $500.00 | $14,500 |
| Concrete Floor | CY | 15 | $500.00 | $7,500 |
| Excavation | CY | 70 | $10.00 | $700 |
| Backfill and compaction | CY | 390 | $12.00 | $4,680 |
| Interior Painting | LS | 1,050 | $6.00 | $6,300 |
| Exterior Painting | LS | 1,050 | $4.00 | $4,200 |
| Handrail | LF | 60 | $15.00 | $900 |
| Miscellaneous piping | LS | 1.5 | $5,000.00 | $7,500 |
| Miscellaneous metal works | LS | 1.5 | $2,000.00 | $3,000 |
| | | | | |
| **Equipment** | | | | |
| 10 hp rapid mixer | EA | 1 | $20,800.00 | $20,800 |
| Alum Chemical feed system | EA | 1 | $96,000.00 | $96,000 |
| Polymer feed system | EA | 1 | $20,800.00 | $20,800 |
| | | | | |
| **New 3-stage Tertiary Flocculation Tank (24x36x13)** | | | | |
| Concrete Walls | CY | 280 | $500.00 | $140,000 |
| Concrete Floor | CY | 100 | $500.00 | $50,000 |
| Excavation | CY | 3,800 | $10.00 | $38,000 |
| Backfill and compaction | CY | 1,600 | $12.00 | $19,200 |
| Interior Painting | LS | 5,400 | $6.00 | $32,400 |
| Exterior Painting | LS | 3,800 | $4.00 | $15,200 |
| Handrail | LF | 240 | $15.00 | $3,600 |
| Miscellaneous piping | LS | 1 | $30,000.00 | $30,000 |
| Miscellaneous metal works | LS | 1 | $34,000.00 | $34,000 |
| | | | | |
| **Equipment** | | | | |
| 1.0 hp mixer - first stage | EA | 2 | $24,000.00 | $48,000 |
| 0.5 hp mixer - second stage | EA | 2 | $24,000.00 | $48,000 |
| 0.5 hp mixer - third stage | EA | 2 | $24,000.00 | $48,000 |
| | | | | |
| **New Tertiary Clarifiers (two 80ft dia x 12ft SWD)** | | | | |
| Concrete Walls | CY | 400 | $500.00 | $200,000 |
| Concrete Floor | CY | 560 | $500.00 | $280,000 |
| Concrete Walkway | CY | 18 | $500.00 | $9,000 |
| Stairs | LS | 2 | $2,000.00 | $4,000 |
| Excavation | CY | 14,000 | $10.00 | $140,000 |
| Backfill and compaction | CY | 4,600 | $12.00 | $55,200 |
| Interior Painting | LS | 2,400 | $6.00 | $14,400 |
| Exterior Painting | LS | 2,400 | $4.00 | $9,600 |
| Miscellaneous piping | LS | 2 | $12,000.00 | $24,000 |
| | | | | |
| Clarifier Equipment | EA | 2 | $369,000.00 | $738,000 |

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| **1.25 Sludge Recyle Facility** | | | | | |
| Assume Building 40x40 | | SF | 1600 | $150.00 | $240,000 |
| Process pumps and piping | | LS | 1 | $250,000.00 | $250,000 |
| SUBTOTAL | | | | | $2,657,480.00 |
| Undefined Elements | 15.00% | | | | $398,622 |
| General Conditions | 4.00% | | | | $106,299 |
| Mobilization & Shakedown | 3.00% | | | | $79,724 |
| TOTAL | | | | | $3,242,000 |

## TABLE 6-6

## CONCEPTUAL COST FOR CHEMICAL PHOSPHORUS REMOVAL FROM 3.75 MGD

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **New Tertiary Rapid Mix Box (12x12x12)** | | | | |
| Concrete Walls | CY | 29 | $500.00 | $14,500 |
| Concrete Floor | CY | 15 | $500.00 | $7,500 |
| Excavation | CY | 70 | $10.00 | $700 |
| Backfill and compaction | CY | 390 | $12.00 | $4,680 |
| Interior Painting | LS | 1,050 | $6.00 | $6,300 |
| Exterior Painting | LS | 1,050 | $4.00 | $4,200 |
| Handrail | LF | 60 | $15.00 | $900 |
| Miscellaneous piping | LS | 1.5 | $5,000.00 | $7,500 |
| Miscellaneous metal works | LS | 1.5 | $2,000.00 | $3,000 |
| | | | | |
| **Equipment** | | | | |
| 10 hp rapid mixer | EA | 1 | $20,800.00 | $20,800 |
| Alum Chemical feed system | EA | 1 | $96,000.00 | $96,000 |
| Polymer feed system | EA | 1 | $20,800.00 | $20,800 |
| | | | | |
| **New 3-stage Tertiary Flocculation Tank (24x36x13)** | | | | |
| Concrete Walls | CY | 280 | $500.00 | $140,000 |
| Concrete Floor | CY | 100 | $500.00 | $50,000 |
| Excavation | CY | 3,800 | $10.00 | $38,000 |
| Backfill and compaction | CY | 1,600 | $12.00 | $19,200 |
| Interior Painting | LS | 5,400 | $6.00 | $32,400 |
| Exterior Painting | LS | 3,800 | $4.00 | $15,200 |
| Handrail | LF | 240 | $15.00 | $3,600 |
| Miscellaneous piping | LS | 1 | $30,000.00 | $30,000 |
| Miscellaneous metal works | LS | 1 | $34,000.00 | $34,000 |
| | | | | |
| **Equipment** | | | | |
| 1.0 hp mixer – first stage | EA | 2 | $24,000.00 | $48,000 |
| 0.5 hp mixer - second stage | EA | 2 | $24,000.00 | $48,000 |
| 0.5 hp mixer – third stage | EA | 2 | $24,000.00 | $48,000 |
| | | | | |
| **New Tertiary Clarifiers (two 80ft dia x 12ft SWD)** | | | | |
| Concrete Walls | CY | 600 | $500.00 | $300,000 |
| Concrete Floor | CY | 840 | $500.00 | $420,000 |
| Concrete Walkway | CY | 27 | $500.00 | $13,500 |
| Stairs | LS | 3 | $2,000.00 | $6,000 |
| Excavation | CY | 21,000 | $10.00 | $210,000 |
| Backfill and compaction | CY | 6,900 | $12.00 | $82,800 |
| Interior Painting | LS | 3,600 | $6.00 | $21,600 |
| Exterior Painting | LS | 3,600 | $4.00 | $14,400 |
| Miscellaneous piping | LS | 3 | $12,000.00 | $36,000 |
| | | | | |
| Clarifier Equipment | EA | 3 | $369,000.00 | $1,107,000 |

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| **1.25 Sludge Recyle Facility** | | | | | |
| Assume Building 40x40 | | SF | 1600 | $150.00 | $240,000 |
| Process pumps and piping | | LS | 1.5 | $250,000.00 | $375,000 |
| | | | | | |
| SUBTOTAL | | | | | $3,519,580.00 |
| Undefined Elements | 15.00% | | | | $527,937 |
| General Conditions | 4.00% | | | | $140,783 |
| Mobilization & Shakedown | 3.00% | | | | $105,587 |
| TOTAL | | | | | $4,294,000 |

This section presents a cost estimate for a throughput chemical treatment system, as well as an overall project cost for a plant that meets an effluent standard of 0.1 mg/l phosphorus. For ease of comparison, the cost estimate for a conventional BNR system, presented in Table 6-4, is used as a basis for comparison. This cost is also shown in Tables 5-3 and 5-4, and a detailed estimate is presented in Appendix D.

Table 6-5 shows a base cost estimate of a system for chemical phosphorus removal from 2.5 mgd of plant throughput, to an effluent standard of 0.1 mg/l. This cost includes undefined elements but does not include construction contingency or gross receipts tax. As shown, the additional Phase I cost of a throughput phosphorus removal system is roughly $3.2 million. For Phase II, this cost increases to $4.3 million as shown in Table 6-6.

Table 6-7 shows the cost of a throughput phosphorus removal system included in the overall cost of the proposed Phase I project. This overall cost includes construction contingencies and the gross receipts tax. This cost does not include a chemical removal system for plant returns, nor a

**TABLE 6-7**

**CONCEPTUAL CAPITAL PROJECT COST - PHASE I, EFFLUENT P < 0.1 MG/L**

| **Construction Costs** | Amount |
|---|---|
| Anaerobic Selector with Alkalinity Augmentation | $559,000 |
| Aeration Basin and Blowers/Canopy Structure | $4,586,000 |
| Influent Pump Station | $1,332,000 |
| Secondary Clarifiers | $1,520,000 |
| Mechanical Dewatering Facilities | $1,776,000 |
| Aerobic Digester and Blower Structure | $1,227,000 |
| Chemical Phosphorus Removal from 2.5 MGD | $3,242,000 |
| Phosphorus Filtrate Pump Station | |
| UV Disinfection Building | $656,000 |
| Yard Piping Improvements | $439,000 |
| Site Improvements | $176,000 |
| Headworks | $706,000 |
| RAS/WAS Pump Station | $594,000 |
| Laboratory and Administration/Control Building | $1,355,000 |
| Electrical | $2,024,000 |
| Laboratory Testing Services | $100,000 |
| Subtotal | $20,292,000 |
| | |
| Other Support Facilities: | |
| Building in lieu of Blower Canopy | $620,000 |

| | |
|---|---|
| Demolition | $1,441,000 |
| Subtotal | $2,061,000 |
| | |
| Subtotal of New Facilities | $22,353,000 |
| Construction Contingencies @ 10% | $2,235,000 |
| Subtotal | $24,588,000 |
| | |
| NMGRT @ 7.6875% | $1,890,000 |
| Total Construction Costs | $26,478,000 |
| | |
| **Professional Engineering Services Allowance @ 9.5%** | |
| Basic design services and allowance for special services including construction inspection (18 months), soils investigation, surveys, aerial mapping, operation and maintanance manual, and startup services | $2,515,000 |
| | |
| NMGRT @ 6.75% | $170,000 |
| Total Professional Engineering Services | $2,685,000 |
| | |
| **Total Project Costs** | $29,163,000 |

treated returns pump station, both of which were necessary without throughput chemical treatment. As shown, the total project cost is $29,163,000, or roughly $3.3 million more than a system without throughput chemical treatment.

Tables 6-8 and 6-9 estimate the operating costs of Phase I and Phase II throughput chemical treatment systems. Estimates are made of the additional operator hours that will be required over and above that required for the activated sludge plant. The cost of alum is included, but no cost is included for soda ash, since it should not be necessary. Polymer cost is not included, since the rate of polymer addition, and the associated cost, are not significant. The yearly operating costs for Phases I and II are $369,000 and $437,000, respectively.

## TABLE 6-8

## CONCEPTUAL O&M COST OF 2.5 MGD CHEMICAL PHOSPHORUS REMOVAL SYSTEM

| ITEM | UNIT | QUANT. PER DAY | UNIT PRICE | COST ESTIMATE ($/yr) |
|---|---|---|---|---|
| Rapid Mixers | kWh | 491 | $0.08 | $14,347 |
| Flocculators | kWh | 52 | $0.08 | $1,519 |
| Clarifier(s) | kWh | 12 | $0.08 | $351 |
| Alum Sludge Pumps | kWh | 107 | $0.08 | $3,127 |
| Alum Feed Pumps | kWh | 36 | $0.08 | $1,052 |
| Alum | gal | 302 | $1.00 | $110,299 |
| Operations (Supervisor 4 hrs, Operator 8 hrs) | h | 12 | $47.00 | $206,001 |

| | |
|---|---|
| Subtotal System Operation | $336,696 |
| Subtotal System Maintenance (Estimate 1% of capital cost) | $ 32,420 |
| TOTAL ($/yr) | $369,000 |
| Present Worth | $5,491,000 |

## TABLE 6-9

## CONCEPTUAL O&M COST OF 3.75 MGD CHEMICAL PHOSPHORUS REMOVAL SYSTEM

| ITEM | UNIT | QUANT. PER DAY | UNIT PRICE | COST ESTIMATE ($/yr) |
|---|---|---|---|---|
| Rapid Mixers | kWh | 491 | $0.08 | $14,347 |
| Flocculators | kWh | 52 | $0.08 | $1,519 |
| Clarifier(s) | kWh | 18 | $0.08 | $526 |
| Alum Sludge Pumps | kWh | 161 | $0.08 | $4,704 |
| Alum Feed Pumps | kWh | 36 | $0.08 | $1,052 |
| Alum | gal | 453 | $1.00 | $165,449 |
| Operations (Supervisor 4 hrs, Operator 8 hrs) | h | 12 | $47.00 | $206,001 |

| | |
|---|---|
| Subtotal System Operation | $393,598 |
| Subtotal System Maintenance (Estimate 1% of capital cost) | $ 42,940 |
| TOTAL ($/yr) | $437,000 |
| Present Worth | $6,503,000 |

For Phase I, Table 6-10 compares the costs of a plant designed for 1 mg/l effluent phosphorus with a plant designed for 0.1 mg/l effluent phosphorus. The former has a small chemical treatment system for return flows. The latter has a chemical treatment system for the entire plant throughput.

**TABLE 6-10**

**COST COMPARISON, 1 MG/L EFFLUENT PHOSPHORUS VS. 0.1 MG/L**

| Effluent Phosphorus | Capital Cost | Operating Cost ($/yr) | Present Worth |
|---|---|---|---|
| < 1 mg/l | $25,897,000 | $585,000 | $34,602,000 |
| < 0.1 mg/l | $29,163,000 | $954,000 | $43,359,000 |
| Difference | $3,266,000 | $369,000 | $8,757,000 |

As shown in Table 6-10, for Phase I flows, the reduction of effluent phosphorus to 0.1 mg/l costs an additional $3.3 million in capital costs, above that required for reduction of effluent phosphorus to 1 mg/l. The additional operating cost is $369,000, and the additional present worth of cost is $8.8 million, assuming a 20-year life cycle with no salvage value and three percent interest.

For Phase II flows, the added cost of phosphorus reduction to 0.1 mg/l is roughly $4.3 million initially, $437,000 in yearly O&M, and $10.8 million in present worth.

## 6.7 References


1. Wastewater Facilities Plan, Molzen-Corbin & Associates, 1993.
2. Federal Emergency Management Agency, Panel 35033 0104C, 1994.
3. Daniel Engineering Company, Plans for Regional Wastewater Facilities – Ruidoso and Ruidoso Downs, As Built, 1982.
4. New Mexico Environment Department (NMED) Standards.
5. Manufacturer's recommendations.
6. Environmental Protection Agency, Nitrogen Control, 1993.
7. Metcalf & Eddy, Wastewater Engineering, 4th Ed., 2003.

8. Texas Commission on Environmental Quality (TCEQ) Standards.
9. Water and Environment Federation, Design of Municipal Wastewater Treatment Plants, 1992.

## 7.0 CONCLUSIONS AND RECOMMENDATIONS

This Section summarizes the results of Sections 1 through 6 and provides recommendations based on the information contained therein.

### 7.1 Conclusions

- The existing plant is out of compliance with the effluent discharge permit currently in force, primarily for the following reasons:
  - The plant does not meet the stringent phosphorus discharge limitation of 0.1 mg/l.
  - The plant does not currently test the effluent for whole effluent toxicity (WET), as required by the permit.
- The existing plant is overloaded with respect to the current permit.
- For planning, the optimal period is starts in 2005 and ends in 2030.
- By 2030, the rate of wastewater influent is expected to meet or exceed 3.75 mgd.
- Due to the magnitude of the required expansion, it should be carried out in two phases. Phase I should expand the plant to 2.5 mgd, and this phase should be carried out as soon as possible. Phase II should expand the plant to 3.75 mgd, and it should be carried out when it becomes necessary. It may not become necessary before the year 2030, which is the end of the planning period for this report.
- The expanded plant must remove phosphorus and total nitrogen.
- Of all the existing components, only the existing secondary clarifiers and plant outfall are suitable for reuse in an expanded plant (not as secondary clarifiers, but possibly for other purposes).
- The plant has insufficient space to install this technology without construction staging.
- The existing sludge drying beds cannot handle the sludge load currently applied. This issue requires immediate attention if Ruidoso is to avoid paying high sludge disposal costs.

## 7.2 Recommendations

As noted in Section 7.1, Ruidoso's most immediate problem is the insufficient capacity of the sludge drying beds. If they are unable to finish enough sludge, they will pay extremely high fees to have partially dried sludge removed from the plant and discarded. Ruidoso prefers to avoid this by renovating the sludge disposal process as soon as possible.

Additionally, Ruidoso must expand the plant as necessary to meet applicable regulations and accommodate future flows.

The existing plant is old, and most of it is either in poor condition or undersized with respect to the current permit. The technology it uses is antiquated and not recommended for cold climates.

As such, the following is recommended for the Ruidoso WWTP:

- Commence as soon as possible a design project for the installation of a 2-meter belt thickener and a 2-meter belt press, both within a new building. Equip the building with a truck loading bay. After the units are installed, re-route WAS to the belt thickener, and pump the thickened sludge to the existing digester. Pump digested sludge to the belt press, and load the dewatered sludge to a truck. Use the existing sludge drying beds for windrow composting, if necessary.
- Carry out the Phase I expansion to 2.5 mgd capacity. Design the expanded plant as described in Section 6.
- Acquire roughly 2 acres of additional land to the west of the plant, if possible, to avoid construction staging.

## 7.3 Special Needs

Ruidoso seeks to upgrade its sludge handling process as soon as possible, and a design project is to commence immediately. To expedite the installation and startup of the new process, the two required belt presses should be pre-ordered by Ruidoso, because the lead time for the equipment is long, and it is most efficient if the project can proceed while the belts are in production.

# APPENDIX B

# NPDES PERMIT

Region 6
1445 Ross Avenue
Dallas, Texas 75202-2733

NPDES Permit No. NM0029165

# AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM

In compliance with the provisions of the Clean Water Act, as amended, (33 U.S.C. 1251 et. seq; the "Act"),

RECEIVED
JAN 1 4 2002
MOLZEN-CORBIN & ASSOCIATES

Ruidoso-Ruidoso Downs WWTP
313 Cree Meadows Drive
Ruidoso, NM 88345

is authorized to discharge to receiving waters named the Rio Ruidoso; thence to the Rio Hondo; thence to the Pecos River in Segment No. 20.6.4.208 of the Pecos River Basin,

from a facility located at 313 Cree Meadows Drive in Lincoln County, New Mexico.

The discharge is located on that water at the following coordinates:

Outfall 001: Latitude: 33° 21' 38" N, Longitude: 105° 32' 35" W

in accordance with effluent limitations, monitoring requirements and other conditions set forth in Parts I, II, III, and IV hereof.

This permit supersedes and replaces NPDES Permit No. NM0029165 issued July 29, 1994.

This permit shall become effective on January 1, 2001

This permit and the authorization to discharge shall expire at midnight, August 31, 2005.

Issued on November 17, 2000

Sam Becker
Acting Director
Water Quality Protection Division (6WQ)

Prepared by

Catherine G. Penland
Environmental Scientist
Permits Section (6WQ-PP)

Permit No. NM0029165

## SECTION A. LIMITATIONS AND MONITORING REQUIREMENTS.

**Final Effluent limits - 2.6 mgd design flow.**

During the period beginning on the effective date of this permit and lasting through the expiration date of this permit, the permittee is authorized to discharge from outfall serial number 001. Such discharges shall be limited and monitored by the permittee as specified below:

| Effluent Characteristics | Discharge Limitations | | | |
|---|---|---|---|---|
| | kg/day (lbs/day) | Other Units (Specify) | | |
| | 30-day Avg | 30-day Avg | 7-day Avg | Daily Max |
| Flow | N/A | Report(mgd) | N/A | Report(mgd) |
| Biochemical Oxygen Demand (5-day) | 295 (650) | 30 mg/l | 45 mg/l | N/A |
| Total Suspended Solids | 295 (650) | 30 mg/l | 45 mg/l | N/A |
| Fecal Coliform Bacteria (Colonies/100 ml) | N/A | 500 | 500 | |
| Cyanide (Weak acid dissociable)[6] | 0.06 (0.13) | 6.07 μg/l | N/A | 9.1 μg/l |
| Mercury (Total)[6] | 0.00021 (0.00046) | 0.021 μg/l | N/A | 0.014 μg/l |
| Phosphorus [8] | 1 (2.2) | 0.1 mg/l | N/A | 0.15 mg/l |
| Vanadium (Total) [9] | Monitor and Report kg/day(lbs/day) | Monitor and Report (μg/l) | N/A | Monitor and Report (μg/l) |

| Effluent Characteristics | Discharge Monitoring | |
|---|---|---|
| | 30-day Avg Minimum | 7 day Minimum |
| Whole Effluent Toxicity Testing (7 day Static Renewal) [1] | | |
| Ceriodaphnia dubia | Report | Report |
| Pimephales promelas | Report | Report |

After dechlorination and prior to final disposal, the effluent shall contain NO MEASURABLE total residual chlorine (TRC) at any time. NO MEASURABLE will be defined as no detectable concentration of TRC as determined by any approved method established in 40 CFR 136. If during the term of this permit the minimum quantification level for TRC becomes less than 0.019 mg/l, then 0.019 mg/l shall become the effluent limitation. The maximum dechlorinated TRC shall be monitored daily by grab sample.

The pH shall not be less than 6.0 standard units or greater than 9.0 standard units and shall be monitored by grab samples collected at the frequency shown above for Total Suspended Solids.

There shall be no discharge of floating solids or visible foam in other than trace amounts.

Permit No. NM0029165

| Effluent Characteristics | Monitoring Requirements Measurement Frequency | Sample Type |
|---|---|---|
| Flow[2] | Continuous | Totalizing Meter |
| Biochemical Oxygen Demand (5-day) | Once/Week | 6-hour composite |
| Total Suspended Solids | Once/Week | 6-hour composite |
| Fecal Coliform Bacteria (Colonies/100 ml) | Three/Week | Grab |
| Cyanide (Weak acid dissociable)[4, 6] | Once/Quarter | 24-hour composite |
| Mercury (Total)[5, 6] | Once/Quarter | 24-hour composite |
| Phosphorus [7, 8] | Once/Month | 24-hour composite |
| Vanadium (Total)[10] | Once/Quarter | 24-hour composite |
| Whole Effluent Toxicity Testing (7 day Static Renewal) | | |
| Ceriodaphnia dubia | Once/6 months | 24-Hour Composite[3] |
| Pimephales promelas | Once/6 months | 24-Hour Composite[3] |

Footnotes

[1]Monitoring and reporting requirements begin on the effective date of this permit. See Part II, Whole Effluent Toxicity Testing Requirements.

[2]Flow must be monitored and reported as million gallons per day (MGD).

[3]The term "24-hour composite sample" means a sample consisting of a minimum of four (4) grab samples of effluent collected at regular intervals over a normal 24-hour operating day and combined in proportion to flow, or a sample continuously collected in proportion to flow, over a normal 24-hour operating day.

[4]If any individual analytical test result for cyanide (weak acid dissociable) is less than the minimum quantification level (MQL) of 10 µg/l, then a value of zero (0) may be used for that test result for the discharge monitoring report (DMR) calculations and reporting requirements (20 NMAC 6.4, section 20.6.4.11.). The EPA accepted method for sampling and analysis for cyanide (weak acid dissociable) is Method 4500 CN I (Standard Methods, latest edition approved in 40 CFR Part 136).

[5]If any individual analytical test result for total mercury is less than the minimum quantification level (MQL) of 0.2 µg/l, then a value of zero (0) may be used for that test result for the discharge monitoring report (DMR) calculations and reporting requirements (20 NMAC 6.4, section 20.6.4.11.).

[6]Limitations and reporting requirements begin on the effective date of the permit and last until the expiration date of the permit.

[7]If any individual analytical test result for phosphorus is less than the minimum quantification level (MQL) of 0.09 µg/l, then a value of zero (0) may be used for that test result for the discharge monitoring report (DMR) calculations and reporting requirements (20 NMAC 6.4, section 20.6.4.11.).

[8]Monitoring and reporting requirements begin on the effective date of the permit and last until the expiration date of the permit. Limitations begin three (3) years from the effective date of the permit and last until the expiration date of the permit in accordance with the compliance requirements for phosphorus in Part I, Section B. of the permit.

[9]Monitoring and reporting requirements begin on the effective date of the permit and last until the expiration date of the permit.

[10]If any individual analytical test result for vanadium is less than the minimum quantification

level of 50 μg/l, then a value of zero (0) may be used for that test result for the discharge monitoring report (DMR) calculations and reporting requirements (20 NMAC 6.4, section 20.6.4.11.). The EPA accepted method for sampling and analysis for Vanadium (total) is Method 200.7 (Standard Methods, latest edition approved in 40 CFR Part 136).

Samples taken in compliance with the monitoring requirements specified above shall be taken at the discharge from the final treatment unit.

Dilution water used in the toxicity tests will be receiving water collected at a point upstream, but as close as possible to the discharge point.

## SECTION B. COMPLIANCE SCHEDULES.

### FINAL EFFLUENT LIMITATIONS COMPLIANCE SCHEDULE

The permittee shall comply with the following schedule of activities for the attainment of state water quality standards-based final effluent limitations for Phosphorus at Final Outfall 001:

a. Determine exceedance cause(s);
b. Develop control options;
c. Evaluate and select control mechanisms;
d. Implement corrective action; and
e. Attain final effluent limitations no later than three (3) years from the effective date of the permit.

The permittee shall submit quarterly progress reports in accordance with the following schedule. The requirement to submit quarterly progress reports shall expire three (3) years from the effective date of the permit.

<u>PROGRESS REPORT DATE</u>

January 1
April 1
July 1
October 1

The quarterly progress reports shall include a discussion of the interim requirements that have been completed at the time of the report and shall address the progress towards attaining the state water quality standards-based final effluent limitations for Mercury at Final Outfall 001 no later than three (3) years from the effective date of the permit.

Reports of compliance or noncompliance with, or any progress reports on, interim and final requirements contained in any compliance schedule of this permit shall be submitted no later than fourteen (14) days following each schedule date. Any reports of noncompliance shall include the cause of noncompliance, any remedial actions taken, and the probability of meeting the next scheduled requirement.

## SECTION C. MONITORING AND REPORTING.

The permittee shall effectively monitor the operation and efficiency of all treatment and control facilities and the quantity and quality of the treated discharge.

1. Monitoring information required shall be on Discharge Monitoring Report Form EPA 3320-1, as required in Part III, D.4.

    a. Reporting periods shall end on the last day of the month.

    b. The first Discharge Monitoring Report(s) shall represent facility operations from the effective date of the permit through the last day of the month.

    c. Thereafter, the permittee is required to make regular monthly reports as described above and shall submit those reports no later than the 15th day of the month following each reporting period. The annual sludge report required in Part IV of the permit is due on February 19 of each year and covers the previous calendar year from January 1 through December 31.

2. If any 7-day average or daily maximum value exceeds the effluent limitations specified in Part I.A, the permittee shall report the excursion in accordance with the requirements of Part III.D.

3. Any 30-day average, 7-day average, or daily maximum value reported in the required Discharge Monitoring Report which is in excess of the effluent limitation specified in Part I.A shall constitute evidence of violation of such effluent limitation and of this permit.

4. Other measurements of oxygen demand (e.g., TOC and COD) may be substituted for five-day Biochemical Oxygen Demand (BOD5) or for five-day Carbonaceous Biochemical Oxygen Demand (CBOD5), as applicable, where the permittee can demonstrate long-term correlation of the method with BOD5 or CBOD5 values, as applicable, where the permittee can demonstrate long-term correlation of the method with BOD5 or CBOD5 values, as applicable. Details of the correlation procedures used must be submitted and prior approval granted by the permitting authority for this procedure to be acceptable. Data reported must also include evidence to show that the proper correlation continues to exist after approval.

## SECTION A. OTHER REQUIREMENTS.

1. CONTRIBUTING INDUSTRIES AND PRETREATMENT REQUIREMENTS

a. The following pollutants may not be introduced into the treatment facility:

(1) Pollutants which create a fire or explosion hazard in the publicly owned treatment works (POTW), including, but not limited to, wastestreams with a closed cup flashpoint of less than 140 degrees Fahrenheit or 60 degrees Centigrade using the test methods specified in 40 CFR 261.21;

(2) Pollutants which will cause corrosive structural damage to the POTW, but in no case discharges with pH lower than 5.0, unless the works are specifically designed to accommodate such discharges;

(3) Solid or viscous pollutants in amounts which will cause obstruction to the flow in the POTW, resulting in Interference;

(4) Any pollutant, including oxygen demanding pollutants (e.g., BOD), released in a discharge at a flow rate and/or pollutant concentration which will cause Interference with the POTW;

(5) Heat in amounts which will inhibit biological activity in the POTW resulting in Interference but in no case heat in such quantities that the temperature at the POTW treatment plant exceeds 40 degrees Centigrade (104 degrees Fahrenheit) unless the Approval Authority, upon request of the POTW, approves alternate temperature limits;

(6) Petroleum oil, nonbiodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through;

(7) Pollutants which result in the presence of toxic gases, vapors, or fumes within the POTW in a quantity that may cause acute worker health and safety problems; and

(8) Any trucked or hauled pollutants, except at discharge points designated by the POTW.

b. The permittee shall require any indirect discharger to the treatment works to comply with the reporting requirements of Sections 204(b), 307, and 308 of the Act, including any requirements established under 40 CFR Part 403.

c. The permittee shall provide adequate notice of the following:

(1) Any new introduction of pollutants into the treatment works from an indirect discharger which would be subject to Sections 301 and 306 of the Act if it were directly discharging those pollutants; and

(2) Any substantial change in the volume or character of pollutants being introduced into the treatment works by a source introducing pollutants into the treatment works at the time of issuance of the permit.

Any notice shall include information on (i) the quality and quantity of effluent to be introduced into the treatment works, and (ii) any anticipated impact of the change on the quality or quantity of effluent to be discharged from the POTW.

**1. PERMIT EXPIRATION DATE**

The expiration date of this permit is determined to be July 31, 2002, to coordinate with the EPA Basin Statewide Management Approach to Permitting in New Mexico, adopted March 2, 2000. This program, also known as the Statewide Basin Management Approach to permitting, is a comprehensive framework to better coordinate and integrate water resource management activities geographically by river basin. Regulations found at 40 CFR Part 122.46 (c) allow EPA to issue any permit for a duration that is less than the full allowable 5 year term.

**2. PERMIT MODIFICATION AND REOPENER**

The permit may be reopened and modified during the life of the permit if relevant portions of New Mexico's Water Quality Standards for Interstate and Intrastate Streams are revised or remanded by the New Mexico Water Quality Control Commission. In addition, the permit may be reopened and modified during the life of the permit if relevant procedures implementing the Water Quality Standards are either revised or promulgated by the New Mexico Environment Department. Should the State adopt a State water quality standard, this permit may be reopened to establish effluent limitations for the parameter(s) to be consistent with that approved State standard in accordance with 40CFR122.44(d). Modification of the permit is subject to the provisions of 40CFR124.5.

The listing of the receiving stream on the State 303 (d) list of impaired waters categorizes the receiving water as water quality limited; however, no new requirements have yet been established for this facility. The State is presently reevaluating and updating the final effluent limitations necessary to protect water quality standards through the Total Maximum Daily Load (TMDL) process. When final effluent limitations are established in an approved TMDL and updated Water Quality Management Plan (WQMP) and if they are more stringent than those listed in this permit, or controls a pollutant not listed in this permit, then the permit may be modified or revoked and reissued to conform with the approved TMDL and WQMP final effluent limitations.

## SECTION B: WHOLE EFFLUENT TOXICITY TESTING (7-DAY CHRONIC NOEC FRESHWATER)

1. SCOPE AND METHODOLOGY

a. The permittee shall test the effluent for toxicity in accordance with the provisions in this section.

| | |
|---|---|
| APPLICABLE TO FINAL OUTFALL: | **001** |
| REPORTED ON DMR AS FINAL OUTFALL: | **001** |
| CRITICAL DILUTION (%): | **57%** |
| EFFLUENT DILUTION SERIES (%): | **24%, 32%, 43%, 57%, and 76%** |
| COMPOSITE SAMPLE TYPE: | Defined at PART I |
| TEST SPECIES/METHODS: | 40 CFR Part 136 |

Ceriodaphnia dubia chronic static renewal survival and reproduction test, Method 1002.0, EPA/600/4-91/002 or the most recent update thereof. This test should be terminated when 60% of the surviving females in the control produce three broods.

Pimephales promelas (Fathead minnow) chronic static renewal 7-day larval survival and growth test, Method 1000.0, EPA/600/4-91/002, or the most recent update thereof. A minimum of five (5) replicates with eight (8) organisms per replicate must be used in the control and in each effluent dilution of this test. Monitoring may be reduced to once/6 months if no lethal or sub-lethal effects are demonstrated in any of the first four valid tests submitted.

b. The NOEC (No Observed Effect Concentration) is defined as the greatest effluent dilution which does not result in lethality that is statistically different from the control (0% effluent) at the 95% confidence level.

c. This permit may be reopened to require whole effluent toxicity limits, chemical specific effluent limits, additional testing, and/or other appropriate actions to address toxicity.

2. PERSISTENT LETHALITY

The requirements of this subsection apply only when a toxicity test demonstrates significant lethal effects at the critical dilution. Significant lethal effects are herein defined as a statistically significant difference at the 95% confidence level between the survival of the appropriate test organism in a specified effluent dilution and the control (0% effluent).

a. PART I TESTING FREQUENCY OTHER THAN MONTHLY

i. The permittee shall conduct a total of two (2) additional tests for any species that demonstrates significant lethal effects at the critical dilution. The two additional tests shall be conducted monthly during the next two consecutive months. The permittee shall not substitute either of the two additional tests in lieu of routine toxicity testing. The full report shall be prepared for each test required by this section in accordance with procedures outlined in Item 4 of this section.

ii. If one or both of the two additional tests demonstrates significant lethal effects at the critical dilution, the permittee shall initiate Toxicity Reduction Evaluation (TRE) requirements as specified in Item 5 of this section. The permittee shall notify EPA in writing within 5 days of the failure of any retest, and the TRE initiation date will be the test completion date of the first failed retest.

iii. If one or both of the two additional tests demonstrates significant lethal effects at the critical dilution, the permittee shall henceforth increase the frequency of testing for this species to once per quarter for the life of the permit.

iv. The provisions of Item 2.a are suspended upon submittal of the TRE Action Plan.

b. PART I TESTING FREQUENCY OF MONTHLY

The permittee shall initiate the Toxicity Reduction Evaluation (TRE) requirements as specified in Item 5 of this section when any two of three consecutive monthly toxicity tests exhibit significant lethal effects at the critical dilution.

3. REQUIRED TOXICITY TESTING CONDITIONS

a. TEST ACCEPTANCE

The permittee shall repeat a test, including the control and all effluent dilutions, if the procedures and quality assurance requirements defined in the test methods or in this permit are not satisfied, including the following additional criteria:

i. The toxicity test control (0% effluent) must have survival equal to or greater than 80%.

ii. The mean number of Ceriodaphnia dubia neonates produced per surviving female in the control (0% effluent) must be 15 or more.

iii. The mean dry weight of surviving Fathead minnow larvae at the end of the 7 days in the control (0% effluent) must be 0.25 mg per larva or greater.

iv. The percent coefficient of variation between replicates shall be 40% or less in the control (0% effluent) for: the young of surviving females in the Ceriodaphnia dubia reproduction test; the growth and survival endpoints of the Fathead minnow test.

v. The percent coefficient of variation between replicates shall be 40% or less in the critical dilution, unless significant lethal or nonlethal effects are exhibited for: the young of surviving females in the Ceriodaphnia dubia reproduction test; the growth and survival endpoints of the Fathead minnow test.

Test failure may not be construed or reported as invalid due to a coefficient of variation value of greater than 40%. A repeat test shall be conducted within the required reporting period of any test determined to be invalid.

b. STATISTICAL INTERPRETATION

i. For the Ceriodaphnia dubia survival test, the statistical analyses used to determine if there is a significant difference between the control and the critical dilution shall be Fisher's Exact Test as described in EPA/600/4-91/002 or the most recent update thereof.

ii. For the Ceriodaphnia dubia reproduction test and the Fathead minnow larval survival and growth test, the statistical analyses used to determine if there is a significant difference between the control and the critical dilution shall be in accordance with the methods for determining the No Observed Effect Concentration (NOEC) as described in EPA/600/4-91/002 or the most recent update thereof.

iii. If the conditions of Test Acceptability are met in Item 3.a above and the percent survival of the test organism is equal to or greater than 80% in the critical dilution concentration and all lower dilution concentrations, the test shall be considered to be a passing test, and the permittee shall report an NOEC of not less than the critical dilution for the DMR reporting requirements found in Item 4 below.

c. <u>DILUTION WATER</u>

i. Dilution water used in the toxicity tests will be receiving water collected as close to the point of discharge as possible but unaffected by the discharge. The permittee shall substitute synthetic dilution water of similar pH, hardness, and alkalinity to the closest downstream perennial water for;

(A) toxicity tests conducted on effluent discharges to receiving water classified as intermittent streams; and

(B) toxicity tests conducted on effluent discharges where no receiving water is available due to zero flow conditions.

ii. If the receiving water is unsatisfactory as a result of instream toxicity (fails to fulfill the test acceptance criteria of Item 3.a), the permittee may substitute synthetic dilution water for the receiving water in all subsequent tests provided the unacceptable receiving water test met the following stipulations:

(A) a synthetic dilution water control which fulfills the test acceptance requirements of Item 3.a was run concurrently with the receiving water control;

(B) the test indicating receiving water toxicity has been carried out to completion (i.e., 7 days);

(C) the permittee includes all test results indicating receiving water toxicity with the full report and information required by Item 4 below; and

(D) the synthetic dilution water shall have a pH, hardness, and alkalinity similar to that of the receiving water or closest downstream perennial water not adversely affected by the discharge, provided the magnitude of these parameters will not cause toxicity in the synthetic dilution water.

d. SAMPLES AND COMPOSITES

i. The permittee shall collect a minimum of three flow-weighted composite samples from the outfall(s) listed at Item 1.a above.

ii. The permittee shall collect second and third composite samples for use during 24-hour renewals of each dilution concentration for each test. The permittee must collect the composite samples such that the effluent samples are representative of any periodic episode of chlorination, biocide usage or other potentially toxic substance discharged on an intermittent basis.

iii. The permittee must collect the composite samples so that the maximum holding time for any effluent sample shall not exceed 72 hours. The permittee must have initiated the toxicity test within 36 hours after the collection of the last portion of the first composite sample. Samples shall be chilled to 4 degrees Centigrade during collection, shipping, and/or storage.

iv. If the flow from the outfall(s) being tested ceases during the collection of effluent samples, the requirements for the minimum number of effluent samples, the minimum number of effluent portions and the sample holding time are waived during that sampling period. However, the permittee must collect an effluent composite sample volume during the period of discharge that is sufficient to complete the required toxicity tests with daily renewal of effluent. When possible, the effluent samples used for the toxicity tests shall be collected on separate days if the discharge occurs over multiple days. The effluent composite sample collection duration and the static renewal protocol associated with the abbreviated sample collection must be documented in the full report required in Item 4 of this section.

v. MULTIPLE OUTFALLS: If the provisions of this section are applicable to multiple outfalls, the permittee shall combine the composite effluent samples in proportion to the average flow from the outfalls listed in Item 1.a above for the day the sample was collected. The permittee shall perform the toxicity test on the flow-weighted composite of the outfall samples.

4. REPORTING

a. The permittee shall prepare a full report of the results of all tests conducted pursuant to this section in accordance with the Report Preparation Section of EPA/600/4-91/002, or the most current publication, for every valid or invalid toxicity test initiated whether carried to completion or not. The permittee shall retain each full report pursuant to the provisions of PART III.C.3 of this permit. The permittee shall submit full reports only upon the specific request of the Agency.

b. A valid test for each species must be reported on the DMR during each reporting period specified in PART I of this permit unless the permittee is performing a TRE which may increase the frequency of testing and reporting. Only ONE set of biomonitoring data for each species is to be recorded on the DMR for each reporting period. The data submitted should reflect the LOWEST Survival results for each species during the reporting period. All invalid tests, repeat tests (for invalid tests), and retests (for tests previously failed) performed during the reporting period must be attached to the DMR for EPA review.

c. The permittee shall submit the results of each valid toxicity test on the subsequent monthly DMR for that reporting period in accordance with PART III.D.4 of this permit, as follows below. Submit retest information clearly marked as such with the following month's DMR. Only results of valid tests are to be reported on the DMR.

i. Pimephales promelas (Fathead Minnow)

(A) If the No Observed Effect Concentration (NOEC) for survival is less than the critical dilution, enter a "1"; otherwise, enter a "0" for Parameter No. TLP6C.

(B) Report the NOEC value for survival, Parameter No. TOP6C.

(C) Report the NOEC value for growth, Parameter No. TPP6C.

ii. Ceriodaphnia dubia

(A) If the NOEC for survival is less than the critical dilution, enter a "1"; otherwise, enter a "0" for Parameter No. TLP3B.

(B) Report the NOEC value for survival, Parameter No. TOP3B.

(C) Report the NOEC value for reproduction, Parameter No. TPP3B.

5. TOXICITY REDUCTION EVALUATION (TRE)

a. Within ninety (90) days of confirming lethality in the retests, the permittee shall submit a Toxicity Reduction Evaluation (TRE) Action Plan and Schedule for conducting a TRE. The TRE Action Plan shall specify the approach and methodology to be used in performing the TRE. A Toxicity Reduction Evaluation is an investigation intended to determine those actions necessary to achieve compliance with water quality-based effluent limits by reducing an effluent's toxicity to an acceptable level. A TRE is defined as a step-wise process which combines toxicity testing and analyses of the physical and chemical characteristics of a toxic effluent to identify the constituents causing effluent toxicity and/or treatment methods which will reduce the effluent toxicity. The TRE Action Plan shall lead to the successful elimination of effluent toxicity at the critical dilution and include the following:

i. Specific Activities. The plan shall detail the specific approach the permittee intends to utilize in conducting the TRE. The approach may include toxicity characterizations, identifications and confirmation activities, source evaluation, treatability studies, or alternative approaches. When the permittee conducts Toxicity Characterization Procedures the permittee shall perform multiple characterizations and follow the procedures specified in the documents "Methods for Aquatic Toxicity Identification Evaluations: Phase I Toxicity Characterization Procedures" (EPA-600/6-91/003) and "Toxicity Identification Evaluation: Characterization of Chronically Toxic Effluents, Phase I" (EPA-600/6-91/005F), or alternate procedures. When the permittee conducts Toxicity Identification Evaluations and Confirmations, the permittee shall perform multiple identifications and follow the methods specified in the documents "Methods for Aquatic Toxicity Identification Evaluations, Phase II Toxicity Identification Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/080) and "Methods for Aquatic Toxicity Identification Evaluations, Phase III Toxicity Confirmation Procedures for Samples Exhibiting Acute and Chronic Toxicity" (EPA/600/R-92/081), as appropriate.

The documents referenced above may be obtained through the National Technical Information Service (NTIS) by phone at (703) 487-4650, or by writing:

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA 22161

ii. Sampling Plan (e.g., locations, methods, holding times, chain of custody, preservation, etc.). The effluent sample volume collected for all tests shall be adequate to perform the toxicity test, toxicity characterization, identification and confirmation procedures, and conduct chemical specific analyses when a probable toxicant has been identified;

Where the permittee has identified or suspects specific pollutant(s) and/or source(s) of effluent toxicity, the permittee shall conduct, concurrent with toxicity testing, chemical specific analyses for the identified and/or suspected pollutant(s) and/or source(s) of effluent toxicity. Where lethality was demonstrated within 48 hours of test initiation, each composite sample shall be analyzed independently. Otherwise the permittee may substitute a composite sample, comprised of equal portions of the individual composite samples, for the chemical specific analysis;

iii. Quality Assurance Plan (e.g., QA/QC implementation, corrective actions, etc.); and

iv. Project Organization (e.g., project staff, project manager, consulting services, etc.).

b. The permittee shall initiate the TRE Action Plan within thirty (30) days of plan and schedule submittal. The permittee shall assume all risks for failure to achieve the required toxicity reduction.

c. The permittee shall submit a quarterly TRE Activities Report, with the Discharge Monitoring Report in the months of January, April, July and October, containing information on toxicity reduction evaluation activities including:

i. any data and/or substantiating documentation which identifies the pollutant(s) and/or source(s) of effluent toxicity;

ii. any studies/evaluations and results on the treatability of the facility's effluent toxicity; and

iii. any data which identifies effluent toxicity control mechanisms that will reduce effluent toxicity to the level necessary to meet no significant lethality at the critical dilution.

A copy of the TRE Activities Report shall also be submitted to the state agency.

d. The permittee shall submit a Final Report on Toxicity Reduction Evaluation Activities no later than twenty-eight (28) months from confirming lethality in the retests, which provides information pertaining to the specific control mechanism selected that will, when implemented, result in reduction of effluent toxicity to no significant lethality at the critical dilution. The report will also provide a specific corrective action schedule for implementing the selected control mechanism.

A copy of the Final Report on Toxicity Reduction Evaluation Activities shall also be submitted to the state agency.

## PART III - STANDARD CONDITIONS FOR NPDES PERMITS

### A. GENERAL CONDITIONS

#### 1. INTRODUCTION

In accordance with the provisions of 40 CFR Part 122.41, et. seq., this permit incorporates by reference ALL conditions and requirements applicable to NPDES Permits set forth in the Clean Water Act, as amended, (hereinafter known as the "Act") as well as ALL applicable regulations.

#### 2. DUTY TO COMPLY

The permittee must comply with all conditions of this permit. Any permit noncompliance constitutes a violation of the Act and is grounds for enforcement action; for permit termination, revocation and reissuance, or modification; or for denial of a permit renewal application.

#### 3. TOXIC POLLUTANTS

a. Notwithstanding Part III.A.5, if any toxic effluent standard or prohibition (including any schedule of compliance specified in such effluent standard or prohibition) is promulgated under Section 307(a) of the Act for a toxic pollutant which is present in the discharge and that standard or prohibition is more stringent than any limitation on the pollutant in this permit, this permit shall be modified or revoked and reissued to conform to the toxic effluent standard or prohibition.

b. The permittee shall comply with effluent standards or prohibitions established under Section 307(a) of the Act for toxic pollutants within the time provided in the regulations that established those standards or prohibitions, even if the permit has not yet been modified to incorporate the requirement.

#### 4. DUTY TO REAPPLY

If the permittee wishes to continue an activity regulated by this permit after the expiration date of this permit, the permittee must apply for and obtain a new permit. The application shall be submitted at least 180 days before the expiration date of this permit. The Director may grant permission to submit an application less than 180 days in advance but no later than the permit expiration date. Continuation of expiring permits shall be governed by regulations promulgated at 40 CFR Part 122.6 and any subsequent amendments.

#### 5. PERMIT FLEXIBILITY

This permit may be modified, revoked and reissued, or terminated for cause in accordance with 40 CFR 122.62-64. The filing of a request for a permit modification, revocation and reissuance, or termination, or a notification of planned changes or anticipated noncompliance, does not stay any permit condition.

#### 6. PROPERTY RIGHTS

This permit does not convey any property rights of any sort, or any exclusive privilege.

#### 7. DUTY TO PROVIDE INFORMATION

The permittee shall furnish to the Director, within a reasonable time, any information which the Director may request to determine whether cause exists for modifying, revoking and reissuing, or terminating this permit, or to determine compliance with this permit. The permittee shall also furnish to the Director, upon request, copies of records required to be kept by this permit.

#### 8. CRIMINAL AND CIVIL LIABILITY

Except as provided in permit conditions on "Bypassing" and "Upsets", nothing in this permit shall be construed to relieve the permittee from civil or criminal penalties for noncompliance. Any false or materially misleading representation or concealment of information required to be reported by the provisions of the permit, the Act, or applicable regulations, which avoids or effectively defeats the regulatory purpose of the Permit may subject the Permittee to criminal enforcement pursuant to 18 U.S.C. Section 1001.

#### 9. OIL AND HAZARDOUS SUBSTANCE LIABILITY

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties to which the permittee is or may be subject under Section 311 of the Act.

#### 10. STATE LAWS

Nothing in this permit shall be construed to preclude the institution of any legal action or relieve the permittee from any responsibilities, liabilities, or penalties established pursuant to any applicable State law or regulation under authority preserved by Section 510 of the Act.

#### 11. SEVERABILITY

The provisions of this permit are severable, and if any provision of this permit or the application of any provision of this permit to any circumstance is held invalid, the application of such provision to other circumstances, and the remainder of this permit, shall not be affected thereby.

### B. PROPER OPERATION AND MAINTENANCE

#### 1. NEED TO HALT OR REDUCE NOT A DEFENSE

It shall not be a defense for a permittee in an enforcement action tha[t] it would have been necessary to halt or reduce the permitted activit[y] in order to maintain compliance with the conditions of this permi[t]. The permittee is responsible for maintaining adequate safeguards [to] prevent the discharge of untreated or inadequately treated wast[es] during electrical power failure either by means of alternate pow[er] sources, standby generators or retention of inadequately treat[ed] effluent.

#### 2. DUTY TO MITIGATE

The permittee shall take all reasonable steps to minimize or preve[nt] any discharge in violation of this permit which has a reasonab[le] likelihood of adversely affecting human health or the environmen[t].

C. MONITORING AND RECORDS

INSPECTION AND ENTRY

The permittee shall allow the Director, or an authorized representative, upon the presentation of credentials and other documents as may be required by the law to:

a. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of this permit;

b. Have access to and copy, at reasonable times, any records that must be kept under the conditions of this permit;

c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices or operations regulated or required under this permit; and

d. Sample or monitor at reasonable times, for the purpose of assuring permit compliance or as otherwise authorized by the Act, any substances or parameters at any location.

2. REPRESENTATIVE SAMPLING

Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity.

3. RETENTION OF RECORDS

The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by request of the Director at any time.

4. RECORD CONTENTS

Records of monitoring information shall include:

a. The date, exact place, and time of sampling or measurements;
b. The individual(s) who performed the sampling or measurements;
c. The date(s) and time(s) analyses were performed;
d. The individual(s) who performed the analyses;
e. The analytical techniques or methods used; and
f. The results of such analyses.

5. MONITORING PROCEDURES

a. Monitoring must be conducted according to test procedures approved under 40 CFR Part 136, unless other test procedures have been specified in this permit or approved by the Regional Administrator.

b. The permittee shall calibrate and perform maintenance procedures on all monitoring and analytical instruments at intervals frequent enough to insure accuracy of measurements and shall maintain appropriate records of such activities.

c. An adequate analytical quality control program, including the analyses of sufficient standards, spikes, and duplicate samples to insure the accuracy of all required analytical results shall be maintained by the permittee or designated commercial laboratory.

6. FLOW MEASUREMENTS

Appropriate flow measurement devices and methods consistent with accepted scientific practices shall be selected and used to ensure the accuracy and reliability of measurements of the volume of monitored discharges. The devices shall be installed, calibrated, and maintained to insure that the accuracy of the measurements is consistent with the accepted capability of that type of device. Devices selected shall be capable of measuring flows with a maximum deviation of less than 10% from true discharge rates throughout the range of expected discharge volumes.

D. REPORTING REQUIREMENTS

1. PLANNED CHANGES

a. INDUSTRIAL PERMITS

The permittee shall give notice to the Director as soon as possible of any planned physical alterations or additions to the permitted facility. Notice is required only when:

(1) The alteration or addition to a permitted facility may meet one of the criteria for determining whether a facility is a new source in 40 CFR Part 122.29(b); or,

(2) The alteration or addition could significantly change the nature or increase the quantity of pollutants discharged. This notification applies to pollutants which are subject neither to effluent limitations in the permit, nor to notification requirements listed at Part III.D.10.a.

b. MUNICIPAL PERMITS

Any change in the facility discharge (including the introduction of any new source or significant discharge or significant changes in the quantity or quality of existing discharges of pollutants) must be reported to the permitting authority. In no case are any new connections, increased flows, or significant changes in influent quality permitted that will cause violation of the effluent limitations specified herein.

2. ANTICIPATED NONCOMPLIANCE

The permittee shall give advance notice to the Director of any planned changes in the permitted facility or activity which may result in noncompliance with permit requirements.

3. TRANSFERS

This permit is not transferable to any person except after notice to the Director. The Director may require modification or revocation and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary under the Act.

4. DISCHARGE MONITORING REPORTS AND OTHER REPORTS

Monitoring results must be reported on Discharge Monitoring Report (DMR) Form EPA No. 3320-1 in accordance with the "General Instructions" provided on the form. The permittee shall submit the original DMR signed and certified as required by Part III.D.11 and all other reports required by Part III.D. to the EPA at the address below. Duplicate copies of DMR's and all other reports shall be submitted to the appropriate State agency(ies) at the following address(es):

EPA:
Compliance Assurance and Enforcement Division
Water Enforcement Branch (6EN-W)
U.S. Environmental Protection Agency, Region 6
1445 Ross Avenue
Dallas, TX 75202-2733

New Mexico:
Program Manager
Surface Water Quality Bureau
New Mexico Environment Department
P.O. Box 26110
1190 Saint Francis Drive
Santa Fe, NM 87502

A copy of Whole Effluent Toxicity Testing results shall also be sent to:

U.S. Department of Interior
New Mexico Ecological Services
2105 Osuna NE
Albuquerque, NM 87113
Attn: Joel Lusk

5. ADDITIONAL MONITORING BY THE PERMITTEE

If the permittee monitors any pollutant more frequently than required by this permit, using test procedures approved under 40 CFR Part 136 or as specified in this permit, the results of this monitoring shall be included in the calculation and reporting of the data submitted in the Discharge Monitoring Report (DMR). Such increased monitoring frequency shall also be indicated on the DMR.

6. AVERAGING OF MEASUREMENTS

Calculations for all limitations which require averaging of measurements shall utilize an arithmetic mean unless otherwise specified by the Director in the permit.

7. TWENTY-FOUR HOUR REPORTING

a. The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 24 hours from the time the permittee becomes aware of the circumstances. A written submission shall be provided within 5 days of the time the permittee becomes aware of the circumstances. The report shall contain the following information:

(1) A description of the noncompliance and its cause;

(2) The period of noncompliance including exact dates and times, and if the noncompliance has not been corrected, the anticipated time it is expected to continue; and,

(3) Steps being taken to reduce, eliminate, and prevent recurrence of the noncomplying discharge.

b. The following shall be included as information which must be reported within 24 hours:

(1) Any unanticipated bypass which exceeds any effluent limitation in the permit;

(2) Any upset which exceeds any effluent limitation in the permit; and,

(3) Violation of a maximum daily discharge limitation for any of the pollutants listed by the Director in Part II (industrial permits only) of the permit to be reported within 24 hours.

c. The Director may waive the written report on a case-by-case basis if the oral report has been received within 24 hours.

8. OTHER NONCOMPLIANCE

The permittee shall report all instances of noncompliance not reported under Parts III.D.4 and D.7 and Part I.B (for industrial permits only) at the time monitoring reports are submitted. The reports shall contain the information listed at Part III.D.7.

9. OTHER INFORMATION

Where the permittee becomes aware that it failed to submit any relevant facts in a permit application, or submitted incorrect information in a permit application or in any report to the Director, it shall promptly submit such facts or information.

10. CHANGES IN DISCHARGES OF TOXIC SUBSTANCES

All existing manufacturing, commercial, mining, and silvacultural permittees shall notify the Director as soon as it knows or has reason to believe:

a. That any activity has occurred or will occur which would result in the discharge, on a routine or frequent basis, of any toxic pollutant listed at 40 CFR Part 122, Appendix D, Tables II and III (excluding Total Phenols) which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) One hundred micrograms per liter (100 μg/L);
(2) Two hundred micrograms per liter (200 μg/L) for acrolein and acrylonitrile; five hundred micrograms per liter (500 μg/L) for 2,4-dinitro-phenol and for 2-methyl-4,6-dinitrophenol; and one milligram per liter (1 mg/L) for antimony;
(3) Five (5) times the maximum concentration value reported for that pollutant in the permit application; or
(4) The level established by the Director.

# SEWAGE SLUDGE REQUIREMENTS of Part IV

## INSTRUCTIONS TO PERMITTEES

Select only those Elements and Sections which apply to your sludge reuse or disposal practice.

If your facility utilizes more than one type of disposal or reuse method (for example, Element I and Element II apply) or the quality of your sludge varies (for example, Section II and Section III of Element I apply) use a separate Discharge Monitoring Report (DMR) for each Section that is applicable.

The sludge DMRs shall be due by February 19th of each year and shall cover the previous January through December time period.

**The sludge conditions do not apply to wastewater treatment lagoons where sludge is not wasted for final reuse/disposal. If the sludge is not removed, the permittee shall indicate on the DMR "No Discharge".**

## ELEMENT 1 - LAND APPLICATION



## ELEMENT 2 - SURFACE DISPOSAL



## ELEMENT 3 - MUNICIPAL SOLID WASTE LANDFILL DISPOSAL

# ELEMENT 1 - LAND APPLICATION

## SECTION I. REQUIREMENTS APPLYING TO ALL SEWAGE SLUDGE LAND APPLICATION

### A. General Requirements

1. The permittee shall handle and dispose of sewage sludge in accordance with Section 405 of the Clean Water Act and all other applicable Federal regulations to protect public health and the environment from any reasonably anticipated adverse effects due to any toxic pollutants which may be present in the sludge.

2. If requirements for sludge management practices or pollutant criteria become more stringent than the sludge pollutant limits or acceptable management practices in this permit, or control a pollutant not listed in this permit, this permit may be modified or revoked and reissued to conform to the requirements promulgated at Section 405(d)(2) of the Clean Water Act. If new limits for Molybdenum are promulgated prior to permit expiration, then those limits shall become directly enforceable.

3. In all cases, if the person (permit holder) who prepares the sewage sludge supplies the sewage sludge to another person for land application use or to the owner or lease holder of the land, the permit holder shall provide necessary information to the parties who receive the sludge to assure compliance with these regulations.

4. The permittee shall give prior notice to EPA (Chief, Permits Branch, Water Management Division, Mail Code 6W-P, EPA Region 6, 1445 Ross Avenue, Dallas, Texas 75202) of any planned changes in the sewage sludge disposal practice, in accordance with 40 CFR Part 122.41(l)(1)(iii). These changes may justify the application of permit conditions that are different from or absent in the existing permit. Change in the sludge use or disposal practice may be cause for modification of the permit in accordance with 40 CFR Part 122.62(a)(1).

### B. Testing Requirements

1. Sewage sludge shall be tested once during the life of the permit within one year from the effective date of the permit in accordance with the method specified at 40 CFR 268, Appendix I (Toxicity Characteristic Leaching Procedure (TCLP)) or other approved methods. Sludge shall be tested after final treatment prior to leaving the POTW site. Sewage sludge determined to be a hazardous waste in accordance with 40 CFR Part 261, shall be handled according to RCRA standards for the disposal of hazardous waste in accordance with 40 CFR Part 262. The disposal of sewage sludge determined to be a hazardous waste, in other than a certified hazardous waste disposal facility shall be prohibited. The Information Management Section, telephone no. (214) 665-6750, and the appropriate state agency shall be notified of test failure within 24 hours. A written report shall be provided to this office within 7 days after failing the TCLP. The report will contain test results, certification that unauthorized disposal has not occurred and a summary of alternative disposal plans that comply with RCRA standards for the disposal of hazardous waste. The report shall be addressed to: Director, Multimedia Planning and Permitting Division, EPA Region 6, Mail Code 6PD, 1445 Ross Avenue, Dallas, Texas 75202. A copy of this report shall be sent to the Chief, Water Enforcement Branch, Compliance Assurance and Enforcement Division, Mail Code 6EN-W, at the same street address.

2. Sewage sludge shall not be applied to the land if the concentration of the pollutants exceed the pollutant concentration criteria in Table 1. The frequency of testing for pollutants in Table 1 is found in Element 1, Section I.C.

TABLE 1

| Pollutant | Ceiling Concentration (milligrams per kilogram)* |
|---|---|
| Arsenic | 75 |
| Cadmium | 85 |
| Copper | 4300 |
| Lead | 840 |
| Mercury | 57 |
| Molybdenum | 75 |
| Nickel | 420 |
| PCBs | 49 |
| Selenium | 100 |
| Zinc | 7500 |

* Dry weight basis

3. Pathogen Control

All sewage sludge that is applied to agricultural land, forest, a public contact site, or a reclamation site shall be treated by either the Class A or Class B pathogen requirements. Sewage sludge that is applied to a lawn or home garden shall be treated by the Class A pathogen requirements. Sewage sludge that is sold or given away in a bag shall be treated by Class A pathogen requirements.

a. Six alternatives are available to demonstrate compliance with Class A sewage sludge. All 6 options require either the density of fecal coliform in the sewage sludge be less than 1000 Most Probable Number (MPN) per gram of total solids (dry weight basis), or the density of Salmonella sp. bacteria in the sewage sludge be less than three MPN per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed; at the time the sewage sludge is prepared for sale or given away in a bag or other container for application to the land. Below are the additional requirements necessary to meet the definition of a Class A sludge. Alternatives 5 and 6 are not authorized to demonstrate compliance with Class A sewage sludge in Texas permits.

Alternative 1 - The temperature of the sewage sludge that is used or disposed shall be maintained at a specific value for a period of time. See 503.32(a)(3)(ii) for specific information. This alternative is not applicable to composting.

Alternative 2 - The pH of the sewage sludge that is used or disposed shall be raised to above 12 and shall remain above 12 for 72 hours. The pH shall be defined as the logarithm of the reciprocal of the hydrogen ion concentration measured at 25°C or measured at another temperature and then converted to an equivalent value at 25°C.

The temperature of the sewage sludge shall be above 52 degrees Celsius for 12 hours or longer during the period that the pH of the sewage sludge is above 12.

At the end of the 72 hour period during which the pH of the sewage sludge is above 12, the sewage sludge shall be air dried to achieve a percent solids in the sewage sludge greater than 50 percent.

Alternative 3 - The sewage sludge shall be analyzed for enteric viruses prior to pathogen treatment. The limit for enteric viruses is one Plaque-forming Unit per four grams of total solids (dry weight basis) either before or following pathogen treatment. See 503.32(a)(5)(ii) for specific information. The sewage sludge shall be analyzed for viable helminth ova prior to pathogen treatment. The limit for viable helminth ova is less than one per four grams of total solids (dry weight basis) either before or following pathogen treatment. See 503.32(a)(5)(iii) for specific information.

Alternative 4 - The density of enteric viruses in the sewage sludge shall be less than one Plaque-forming Unit per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed or at the time the sludge is prepared for sale or give away in a bag or other container for application to the land.

The density of viable helminth ova in the sewage sludge shall be less than one per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed or at the time the sewage sludge is prepared for sale or give away in a bag or other container for application to the land.

Alternative 5 - Sewage sludge shall be treated by one of the Processes to Further Reduce Pathogens (PFRP) described in 503 Appendix B. PFRPs include composting, heat drying, heat treatment, and thermophilic aerobic digestion.

Alternative 6 - Sewage sludge shall be treated by a process that is equivalent to a Process to Further Reduce Pathogens, if individually approved by the Pathogen Equivalency Committee representing the EPA.

b. Three alternatives are available to demonstrate compliance with Class B sewage sludge. Alternatives 2 and 3 are not authorized to demonstrate compliance with Class B sewage sludge in Texas permits.

Alternative 1 - (i) Seven representative samples of the sewage sludge that is used shall be collected for one monitoring episode at the time the sewage sludge is used or disposed.

(ii) The geometric mean of the density of fecal coliform in the samples collected shall be less than either 2,000,000 MPN per gram of total solids (dry weight basis) or 2,000,000 Colony Forming Units per gram of total solids (dry weight basis).

Alternative 2 - Sewage sludge shall be treated in one of the Processes to significantly Reduce Pathogens described in 503 Appendix B.

Alternative 3 - Sewage sludge shall be treated in a process that is equivalent to a PSRP, if individually approved by the Pathogen Equivalency Committee representing the EPA.

In addition, the following site restrictions must be met if Class B sludge is land applied:

i. Food crops with harvested parts that touch the sewage sludge/soil mixture and are totally above the land surface shall not be harvested for 14 months after application of sewage sludge.

ii. Food crops with harvested parts below the surface of the land shall not be harvested for 20 months after application of sewage sludge when the sewage sludge remains on the land surface for 4 months or longer prior to incorporation into the soil.

iii. Food crops with harvested parts below the surface of the land shall not be harvested for 38 months after application of sewage sludge when the sewage sludge remains on the land surface for less than 4 months prior to incorporation into the soil.

iv. Food crops, feed crops, and fiber crops shall not be harvested for 30 days after application of sewage sludge.

v. Animals shall not be grazed on the land for 30 days after application of sewage sludge.

vi. Turf grown on land where sewage sludge is applied shall not be harvested for 1 year after application of the sewage sludge when the harvested turf is placed on either land with a high

b. That any activity has occurred or will occur which would result in any discharge, on a nonroutine or infrequent basis, of a toxic pollutant which is not limited in the permit, if that discharge will exceed the highest of the following "notification levels":

(1) Five hundred micrograms per liter (500 µg/L);
(2) One milligram per liter (1 mg/L) for antimony;
(3) Ten (10) times the maximum concentration value reported for that pollutant in the permit application; or
(4) The level established by the Director.

11. SIGNATORY REQUIREMENTS

All applications, reports, or information submitted to the Director shall be signed and certified.

a. ALL PERMIT APPLICATIONS shall be signed as follows:

(1) FOR A CORPORATION - by a responsible corporate officer. For the purpose of this section, a responsible corporate officer means:

(a) A president, secretary, treasurer, or vice-president of the corporation in charge of a principal business function, or any other person who performs similar policy or decision making functions for the corporation; or,

(b) The manager of one or more manufacturing, production, or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), if authority to sign documents has been assigned or delegated to the manager in accordance with corporate procedures.

(2) FOR A PARTNERSHIP OR SOLE PROPRIETORSHIP - by a general partner or the proprietor, respectively.

(3) FOR A MUNICIPALITY, STATE, FEDERAL, OR OTHER PUBLIC AGENCY - by either a principal executive officer or ranking elected official. For purposes of this section, a principal executive officer of a Federal agency includes:

(a) The chief executive officer of the agency, or

(b) A senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.

b. ALL REPORTS required by the permit and other information requested by the Director shall be signed by a person described above or by a duly authorized representative of that person. A person is a duly authorized representative only if:

(1) The authorization is made in writing by a person described above;

(2) The authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity, such as the position of plant manager, operator of a well or a well field, superintendent, or position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company. A duly authorized representative may thus be either a named individual or an individual occupying a named position; and,

(3) The written authorization is submitted to the Director.

c. CERTIFICATION

Any person signing a document under this section shall make the following certification:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

12. AVAILABILITY OF REPORTS

Except for applications, effluent data, permits, and other data specified in 40 CFR 122.7, any information submitted pursuant to this permit may be claimed as confidential by the submitter. If no claim is made at the time of submission, information may be made available to the public without further notice.

E. PENALTIES FOR VIOLATIONS OF PERMIT CONDITIONS

1. CRIMINAL

a. NEGLIGENT VIOLATIONS

The Act provides that any person who negligently violates permit conditions implementing Section 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a fine of not less than $2,500 nor more than $25,000 per day of violation, or by imprisonment for not more than 1 year, or both.

b. KNOWING VIOLATIONS

The Act provides that any person who knowingly violates permit conditions implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a fine of not less than $5,000 nor more than $50,000 per day of violation, or by imprisonment for not more than 3 years, or both.

c. KNOWING ENDANGERMENT

The Act provides that any person who knowingly violates permi[t] conditions implementing Sections 301, 302, 303, 306, 307, 308 318, or 405 of the Act and who knows at that time that he i[s] placing another person in imminent danger of death or seriou[s]

Alternative 9 - (i) Sewage sludge shall be injected below the surface of the land.

(ii) No significant amount of the sewage sludge shall be present on the land surface within one hour after the sewage sludge is injected.

(iii) When sewage sludge that is injected below the surface of the land is Class A with respect to pathogens, the sewage sludge shall be injected below the land surface within eight hours after being discharged from the pathogen treatment process.

Alternative 10 - (i) Sewage sludge applied to the land surface or placed on a surface disposal site shall be incorporated into the soil within six hours after application to or placement on the land.

(ii) When sewage sludge that is incorporated into the soil is Class A with respect to pathogens, the sewage sludge shall be applied to or placed on the land within eight hours after being discharged from the pathogen treatment process.

**C. Monitoring Requirements**

Toxicity Characteristic Leaching Procedure (TCLP) Test - Once/Permit Life, performed within one year from the effective date of the permit

PCBs - Once/Year

All other pollutants shall be monitored at the frequency shown below:

| Amount of sewage sludge* (metric tons per 365 day period) | Frequency |
|---|---|
| $0 \leq$ Sludge $< 290$ | Once/Year |
| $290 \leq$ Sludge $< 1,500$ | Once/Quarter |
| $1,500 \leq$ Sludge $< 15,000$ | Once/Two Months |
| $15,000 \leq$ Sludge | Once/Month |

* Either the amount of bulk sewage sludge applied to the land or the amount of sewage sludge received by a person who prepares sewage sludge that is sold or given away in a bag or other container for application to the land (dry weight basis).

Representative samples of sewage sludge shall be collected and analyzed in accordance with the methods referenced in 40 CFR 503.8(b).

SECTION II. REQUIREMENTS SPECIFIC TO BULK SEWAGE SLUDGE FOR APPLICATION TO THE LAND MEETING CLASS A or B PATHOGEN REDUCTION AND THE CUMULATIVE LOADING RATES IN TABLE 2, OR CLASS B PATHOGEN REDUCTION AND THE POLLUTANT CONCENTRATIONS IN TABLE 3

For those permittees meeting Class A or B pathogen reduction requirements and that meet the cumulative loading rates in Table 2 below, or the Class B pathogen reduction requirements and contain concentrations of pollutants below those listed in Table 3 found in Element I, Section III, the following conditions apply:

bodily injury is subject to a fine of not more than $250,000, or by imprisonment for not more than 15 years, or both.

d. FALSE STATEMENTS

The Act provides that any person who knowingly makes any false material statement, representation, or certification in any application, record, report, plan, or other document filed or required to be maintained under the Act or who knowingly falsifies, tampers with, or renders inaccurate, any monitoring device or method required to be maintained under the Act, shall upon conviction, be punished by a fine of not more than $10,000, or by imprisonment for not more than 2 years, or by both. If a conviction of a person is for a violation committed after a first conviction of such person under this paragraph, punishment shall be by a fine of not more than $20,000 per day of violation, or by imprisonment of not more than 4 years, or by both. (See Section 309.c.4 of the Clean Water Act)

2. CIVIL PENALTIES

The Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to a civil penalty not to exceed $27,000 per day for each violation.

3. ADMINISTRATIVE PENALTIES

The Act provides that any person who violates a permit condition implementing Sections 301, 302, 306, 307, 308, 318, or 405 of the Act is subject to an administrative penalty, as follows:

a. CLASS I PENALTY

Not to exceed $11,000 per violation nor shall the maximum amount exceed $27,000.

b. CLASS II PENALTY

Not to exceed $11,000 per day for each day during which the violation continues nor shall the maximum amount exceed $137,500.

F. DEFINITIONS

All definitions contained in Section 502 of the Act shall apply to this permit and are incorporated herein by reference. Unless otherwise specified in this permit, additional definitions of words or phrases used in this permit are as follows:

1. ACT means the Clean Water Act (33 U.S.C. 1251 et. seq.), as amended.

2. ADMINISTRATOR means the Administrator of the U.S. Environmental Protection Agency.

3. APPLICABLE EFFLUENT STANDARDS AND LIMITATIONS means all state and Federal effluent standards and limitations to which a discharge is subject under the Act, including, but not limited to, effluent limitations, standards or performance, toxic effluent standards and prohibitions, and pretreatment standards.

4. APPLICABLE WATER QUALITY STANDARDS means all water quality standards to which a discharge is subject under the Act.

5. BYPASS means the intentional diversion of waste streams from any portion of a treatment facility.

6. DAILY DISCHARGE means the discharge of a pollutant measured during a calendar day or any 24-hour period that reasonably represents the calendar day for purposes of sampling. For pollutants with limitations expressed in terms of mass, the "daily discharge" is calculated as the total mass of the pollutant discharged over the sampling day. For pollutants with limitations expressed in other units of measurement, the "daily discharge" is calculated as the average of measurement of the pollutant over the sampling day. "Daily discharge" determination of concentration made using a composite sample shall be the concentration of the composite sample. When grab samples are used, the "daily discharge" determination of concentration shall be arithmetic average (weighted by flow value) of all samples collected during that sampling day.

7. DAILY AVERAGE (also known as MONTHLY AVERAGE) discharge limitations means the highest allowable average of "daily discharge(s)" over a calendar month, calculated as the sum of all "daily discharge(s)" measured during a calendar month divided by the number of "daily discharge(s)" measured during that month. When the permit establishes daily average concentration effluent limitations or conditions, the daily average concentration means the arithmetic average (weighted by flow) of all "daily discharge(s)" of concentration determined during the calendar month where C = daily concentration, F = daily flow and n = number of daily samples; daily average discharge =

$$\frac{C_1F_1 + C_2F_2 + \ldots + C_nF_n}{F_1 + F_2 + \ldots + F_n}$$

8. DAILY MAXIMUM discharge limitation means the highest allowable "daily discharge" during the calendar month.

9. DIRECTOR means the U.S. Environmental Protection Agency Regional Administrator or an authorized representative.

10. ENVIRONMENTAL PROTECTION AGENCY means the U.S. Environmental Protection Agency.

11. GRAB SAMPLE means an individual sample collected in less than 15 minutes.

12. INDUSTRIAL USER means a nondomestic discharger, as identified in 40 CFR 403, introducing pollutants to a publicly owned treatment works.

13. NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM means the national program for issuing, modifying, revoking and reissuing, terminating, monitoring and enforcing permits, and imposing and enforcing pretreatment requirements, under Sections 307, 318, 402, and 405 of the Act.

14. SEVERE PROPERTY DAMAGE means substantial physical damage to property, damage to the treatment facilities which causes them to become inoperable, or substantial and permanent loss of natural resources which can reasonably be expected to occur in the absence

of a bypass. Severe property damage does not mean economic loss caused by delays in production.

15. SEWAGE SLUDGE means the solids, residues, and precipitates separated from or created in sewage by the unit processes of a publicly owned treatment works. Sewage as used in this definition means any wastes, including wastes from humans, households, commercial establishments, industries, and storm water runoff, that are discharged to or otherwise enter a publicly owned treatment works.

16. TREATMENT WORKS means any devices and systems used in the storage, treatment, recycling and reclamation of municipal sewage and industrial wastes of a liquid nature to implement Section 201 of the Act, or necessary to recycle or reuse water at the most economical cost over the estimated life of the works, including intercepting sewers, sewage collection systems, pumping, power and other equipment, and their appurtenances, extension, improvement, remodeling, additions, and alterations thereof.

17. UPSET means an exceptional incident in which there is unintentional and temporary noncompliance with technology-based permit effluent limitations because of factors beyond the reasonable control of the permittee. An upset does not include noncompliance to the extent caused by operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventive maintenance, or careless or improper operation.

18. FOR FECAL COLIFORM BACTERIA, a sample consists of one effluent grab portion collected during a 24-hour period at peak loads.

19. The term "MGD" shall mean million gallons per day.

20. The term "mg/L" shall mean milligrams per liter or parts per million (ppm).

21. The term "µg/L" shall mean micrograms per liter or parts per billion (ppb).

22. MUNICIPAL TERMS

   a. 7-DAY AVERAGE or WEEKLY AVERAGE, other than for fecal coliform bacteria, is the arithmetic mean of the daily values for all effluent samples collected during a calendar week, calculated as the sum of all daily discharges measured during a calendar week divided by the number of daily discharges measured during that week. The 7-day average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calendar week.

   b. 30-DAY AVERAGE or MONTHLY AVERAGE, other than for fecal coliform bacteria, is the arithmetic mean of the daily values for all effluent samples collected during a calendar month, calculated as the sum of all daily discharges measured during a calendar month divided by the number of daily discharges measured during that month. The 30-day average for fecal coliform bacteria is the geometric mean of the values for all effluent samples collected during a calendar month.

   c. 24-HOUR COMPOSITE SAMPLE consists of a minimum of 12 effluent portions collected at equal time intervals over the 24-hour period and combined proportional to flow or a sample collected at frequent intervals proportional to flow over the 24-hour period.

   d. 12-HOUR COMPOSITE SAMPLE consists of 12 effluent portions collected no closer together than one hour and composited according to flow. The daily sampling intervals shall include the highest flow periods.

   e. 6-HOUR COMPOSITE SAMPLE consists of six effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) and composited according to flow.

   f. 3-HOUR COMPOSITE SAMPLE consists of three effluent portions collected no closer together than one hour (with the first portion collected no earlier than 10:00 a.m.) and composited according to flow.

potential for public exposure or a lawn, unless otherwise specified by the permitting authority.

vii. Public access to land with a high potential for public exposure shall be restricted for 1 year after application of sewage sludge.

viii. Public access to land with a low potential for public exposure shall be restricted for 30 days after application of sewage sludge.

4. Vector Attraction Reduction Requirements

All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, or a reclamation site shall be treated by one of the following alternatives 1 through 10 for Vector Attraction Reduction. If bulk sewage sludge is applied to a home garden, or bagged sewage sludge is applied to the land, only alternative 1 through alternative 8 shall be used.

<u>Alternative 1</u> - The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38 percent.

<u>Alternative 2</u> - If Alternative 1 cannot be met for an anaerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge anaerobically in the laboratory in a bench-scale unit for 40 additional days at a temperature between 30 and 37 degrees Celsius. Volatile solids must be reduced by less than 17 percent to demonstrate compliance.

<u>Alternative 3</u> - If Alternative 1 cannot be met for an aerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge with a percent solids of two percent or less aerobically in the laboratory in a bench-scale unit for 30 additional days at 20 degrees Celsius. Volatile solids must be reduced by less than 15 percent to demonstrate compliance.

<u>Alternative 4</u> - The specific oxygen uptake rate (SOUR) for sewage sludge treated in an aerobic process shall be equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature of 20 degrees Celsius.

<u>Alternative 5</u> - Sewage sludge shall be treated in an aerobic process for 14 days or longer. During that time, the temperature of the sewage sludge shall be higher than 40 degrees Celsius and the average temperature of the sewage sludge shall be higher than 45 degrees Celsius.

<u>Alternative 6</u> - The pH of sewage sludge shall be raised to 12 or higher by alkali addition and, without the addition of more alkali shall remain at 12 or higher for two hours and then at 11.5 or higher for an additional 22 hours at the time the sewage sludge is used or disposed; at the time the sewage sludge is prepared for sale or given away in a bag or other container.

<u>Alternative 7</u> - The percent solids of sewage sludge that does not contain unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 75 percent based on the moisture content and total solids prior to mixing with other materials at the time the sludge is used. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or anaerobic treatment process.

<u>Alternative 8</u> - The percent solids of sewage sludge that contains unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 90 percent based on the moisture content and total solids prior to mixing with other materials at the time the sludge is used. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or anaerobic treatment process.

1. Pollutant Limits

Table 2

| Pollutant | Cumulative Pollutant Loading Rate (kilograms per hectare) |
|---|---|
| Arsenic | 41 |
| Cadmium | 39 |
| Copper | 1500 |
| Lead | 300 |
| Mercury | 17 |
| Molybdenum | Report |
| Nickel | 420 |
| Selenium | 100 |
| Zinc | 2800 |

2. Pathogen Control

All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, a reclamation site, or lawn or home garden shall be treated by either Class A or Class B pathogen reduction requirements as defined above in Element 1, Section I.B.3.

3. Management Practices

a. Bulk sewage sludge shall not be applied to agricultural land, forest, a public contact site, or a reclamation site that is flooded, frozen, or snow-covered so that the bulk sewage sludge enters a wetland or other waters of the U.S., as defined in 40 CFR 122.2, except as provided in a permit issued pursuant to section 404 of the CWA.

b. Bulk sewage sludge shall not be applied within 10 meters of a water of the U.S.

c. Bulk sewage sludge shall be applied at or below the agronomic rate in accordance with recommendations from the following references:

i. <u>STANDARDS 1992, Standards, Engineering Practices and Data</u>, 39th Edition (1992) American Society of Agricultural Engineers, 2950 Niles Road, St. Joseph, MI 49085-9659.

ii. <u>National Engineering Handbook</u> Part 651, Agricultural Waste Management Field Handbook (1992), P.O. Box 2890, Washington, D.C. 20013.

iii. Recommendations of local extension services or Soil Conservation Services.

iv. Recommendations of a major University's Agronomic Department.

d. An information sheet shall be provided to the person who receives bulk sewage sludge sold or given away. The information sheet shall contain the following information:

i. The name and address of the person who prepared the sewage sludge that is sold or given away in a bag or other container for application to the land.

ii. A statement that application of the sewage sludge to the land is prohibited except in accordance with the instructions on the label or information sheet.

iii. The annual whole sludge application rate for the sewage sludge that does not cause any of the cumulative pollutant loading rates in Table 2 above to be exceeded, unless the pollutant concentrations in Table 3 found in Element I, Section III below are met.

4. Notification requirements

a. If bulk sewage sludge is applied to land in a State other than the State in which the sludge is prepared, written notice shall be provided prior to the initial land application to the permitting authority for the State in which the bulk sewage sludge is proposed to be applied. The notice shall include:

i. The location, by either street address or latitude and longitude, of each land application site.

ii. The approximate time period bulk sewage sludge will be applied to the site.

iii. The name, address, telephone number, and National Pollutant Discharge Elimination System permit number (if appropriate) for the person who prepares the bulk sewage sludge.

iv. The name, address, telephone number, and National Pollutant Discharge Elimination System permit number (if appropriate) for the person who will apply the bulk sewage sludge.

b. The permittee shall give 60 days prior notice to the Director of any change planned in the sewage sludge practice. Any change shall include any planned physical alterations or additions to the permitted treatment works, changes in the permittee's sludge use or disposal practice, and also alterations, additions, or deletions of disposal sites. These changes may justify the application of permit conditions that are different from or absent in the existing permit, including notification of additional disposal sites not reported during the permit application process or absent in the existing permit. Change in the sludge use or disposal practice may be cause for modification of the permit in accordance with 40 CFR 122.62(a)(1).

c. The permittee shall provide the location of all new sludge disposal/use sites where previously undisturbed ground is proposed for disturbance to the State Historical Commission within 90 days of the effective date of this permit. In addition, the permittee shall provide the location of any new disposal/use site to the State Historical Commission prior to use of the site.

The permittee shall within 30 days after notification by the State Historical Commission that a specific sludge disposal/use area will adversely effect a National Historic Site, cease use of such area.

5. Recordkeeping Requirements - The sludge documents will be retained on site at the same location as other NPDES records.

The person who prepares bulk sewage sludge or a sewage sludge material shall develop the following information and shall retain the information for <u>five years</u>. If the permittee supplies the sludge to another person who land applies the sludge, the permittee shall notify the land applier of the requirements for recordkeeping found in 40 CFR 503.17 for persons who land apply.

a. The concentration (mg/Kg) in the sludge of each pollutant listed in Table 3 found in Element I, Section III and the applicable pollutant concentration criteria (mg/Kg), <u>or</u> the applicable cumulative pollutant loading rate and the applicable cumulative pollutant loading rate limit (kg/ha) listed in Table 2 above.

b. A description of how the pathogen reduction requirements are met (including site restrictions for Class B sludges, if applicable).

c. A description of how the vector attraction reduction requirements are met.

d. A description of how the management practices listed above in Section II.3 are being met.

e. The recommended agronomic loading rate from the reference's listed in Section II.3.c. above, as well as the actual agronomic loading rate shall be retained.

f. A description of how the site restrictions in 40 CFR Part 503.32(b)(5) are met for each site on which Class B bulk sewage sludge is applied.

g. The following certification statement:

"I certify, under penalty of law, that the information that will be used to determine compliance with the management practices in §503.14 have been met for each site on which bulk sewage sludge is applied. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the management practices have been met. I am aware that there are significant penalties for false certification including fine and imprisonment."

h. A certification statement that all applicable requirements (specifically listed) have been met, and that the permittee understands that there are significant penalties for false certification including fine and imprisonment. See 40 CFR 503.17(a)(4)(i)(B) or 40 CFR Part 503.17(a)(5)(i)(B) as applicable to the permittees sludge treatment activities.

i. The permittee shall maintain information that describes future geographical areas where sludge may be land applied.

j. The permittee shall maintain information identifying site selection criteria regarding land application sites not identified at the time of permit application submission.

k. The permittee shall maintain information regarding how future land application sites will be managed.

The person who prepares bulk sewage sludge or a sewage sludge material shall develop the following information and shall retain the information indefinitely. If the permittee supplies the sludge to another person who land applies the sludge, the permittee shall notify the land applier of the requirements for recordkeeping found in 40 CFR 503.17 for persons who land apply.

a. The location, by either street address or latitude and longitude, of each site on which sludge is applied.

b. The number of hectares in each site on which bulk sludge is applied.

c. The date and time sludge is applied to each site.

d. The cumulative amount of each pollutant in kilograms/hectare listed in Table 2 applied to each site.

e. The total amount of sludge applied to each site in metric tons.

f. The following certification statement:

"I certify, under penalty of law, that the information that will be used to determine compliance with the requirements to obtain information in §503.12(e)(2) have been met for each site on which bulk sewage sludge is applied. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the requirements to obtain information have been met. I am aware that there are significant penalties for false certification including fine and imprisonment."

g. A description of how the requirements to obtain information in §503.12(e)(2) are met.

6. Reporting Requirements - The permittee shall report annually on the DMR the following information:

a. Pollutant Table (2 or 3) appropriate for permittee's land application practices.

b. The frequency of monitoring listed in Element 1, Section I.C. which applies to the permittee.

c. Toxicity Characteristic Leaching Procedure (TCLP) results (Pass/Fail).

d. The concentration (mg/Kg) in the sludge of each pollutant listed in Table 1 (defined as a monthly average) as well as the applicable pollutant concentration criteria (mg/Kg) listed in Table 3 found in Element 1, Section III, or the applicable pollutant loading rate limit (kg/ha) listed in Table 2 above if it exceeds 90% of the limit.

e. Level of pathogen reduction achieved (Class A or Class B).

f. Alternative used as listed in Section I.B.3.(a. or b.). Alternatives describe how the pathogen reduction requirements are met. If Class B sludge, include information on how site restrictions were met in the DMR comment section or attach a separate sheet to the DMR.

g. Vector attraction reduction alternative used as listed in Section I.B.4.

h. Annual sludge production in dry metric tons/year.

i. Amount of sludge land applied in dry metric tons/year.

j. Amount of sludge transported interstate in dry metric tons/year.

k. The certification statement listed in 503.17(a)(4)(i)(B) or 503.17(a)(5)(i)(B) whichever applies to the permittees sludge treatment activities shall be attached to the DMR.

l. When the amount of any pollutant applied to the land exceeds 90% of the cumulative pollutant loading rate for that pollutant, as described in Table 2, the permittee shall report the following information as an attachment to the DMR.

   i. The location, by either street address or latitude and longitude.

   ii. The number of hectares in each site on which bulk sewage sludge is applied.

   iii. The date and time bulk sewage sludge is applied to each site.

   iv. The cumulative amount of each pollutant (i.e., kilograms/hectare) listed in Table 2 in the bulk sewage sludge applied to each site.

   v. The amount of sewage sludge (i.e., metric tons) applied to each site.

   vi. The following certification statement:

"I certify, under penalty of law, that the information that will be used to determine compliance with the requirements to obtain information in 40 CFR 503.12(e)(2) have been met for each site on which bulk sewage sludge is applied. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the requirements to obtain information have been met. I am aware that there are significant penalties for false certification including fine and imprisonment."

vii. A description of how the requirements to obtain information in 40 CFR 503.12(e)(2) are met.

## SECTION III. REQUIREMENTS SPECIFIC TO BULK OR BAGGED SEWAGE SLUDGE MEETING POLLUTANT CONCENTRATIONS IN TABLE 3 AND CLASS A PATHOGEN REDUCTION REQUIREMENTS

For those permittees with sludge that contains concentrations of pollutants below those pollutant limits listed in Table 3 for bulk or bagged (containerized) sewage sludge and also meet the Class A pathogen reduction requirements, the following conditions apply (Note: All bagged sewage sludge must be treated by Class A pathogen reduction requirements.):

1. Pollutant limits - The concentration of the pollutants in the municipal sewage sludge is at or below the values listed.

Table 3

| Pollutant | Monthly Average Concentration (milligrams per kilogram)* |
|---|---|
| Arsenic | 41 |
| Cadmium | 39 |
| Copper | 1500 |
| Lead | 300 |
| Mercury | 17 |
| Molybdenum | Report |
| Nickel | 420 |
| Selenium | 100 |
| Zinc | 2800 |

* Dry weight basis

2. Pathogen Control

   All bulk sewage sludge that is applied to agricultural land, forest, a public contact site, a reclamation site, or lawn or home garden shall be treated by the Class A pathogen reduction requirements as defined above in Element I, Section I.B.3. All bagged sewage sludge must be treated by Class A pathogen reduction requirements.

3. Management Practices - None.

4. Notification Requirements - None.

5. Recordkeeping Requirements - The permittee shall develop the following information and shall retain the information for five years. The sludge documents will be retained on site at the same location as other NPDES records.

   a. The concentration (mg/Kg) in the sludge of each pollutant listed in Table 3 and the applicable pollutant concentration criteria listed in Table 3.

   b. A certification statement that all applicable requirements (specifically listed) have been met, and that the permittee understands that there are significant penalties for false certification including fine and imprisonment. See 503.17(a)(1)(ii) or 503.17(a)(3)(i)(B), whichever applies to the permittees sludge treatment activities.

   c. A description of how the Class A pathogen reduction requirements are met.

   d. A description of how the vector attraction reduction requirements are met.

6. Reporting Requirements - The permittee shall report annually on the DMR the following information:

a. Pollutant Table 3 appropriate for permittee's land application practices.

b. The frequency of monitoring listed in Element 1, Section I.C. which applies to the permittee.

c. Toxicity Characteristic Leaching Procedure (TCLP) results. (Pass/Fail).

d. The concentration (mg/Kg) in the sludge of each pollutant listed in Table 1 (defined as a monthly average) found in Element 1, Section I. In addition, the applicable pollutant concentration criteria listed in Table 3 should be included on the DMR.

e. Pathogen reduction Alternative used for Class A bagged or bulk sludge as listed in Section I.B.3.a.

f. Vector attraction reduction Alternative used as listed in Section I.B.4.

g. Annual sludge production in dry metric tons/year.

h. Amount of sludge land applied in dry metric tons/year.

i. Amount of sludge transported interstate in dry metric tons/year.

j. The certification statement listed in 503.17(a)(1)(ii) or 503.17(a)(3)(i)(B), whichever applies to the permittees sludge treatment activities, shall be attached to the DMR.

## SECTION IV. REQUIREMENTS SPECIFIC TO SLUDGE SOLD OR GIVEN AWAY IN A BAG OR OTHER CONTAINER FOR APPLICATION TO THE LAND THAT DOES NOT MEET THE MINIMUM POLLUTANT CONCENTRATIONS

1. Pollutant Limits

Table 4

| Pollutant | Annual Pollutant Loading Rate (kilograms per hectare per 365 day period) |
|---|---|
| Arsenic | 2 |
| Cadmium | 1.9 |
| Copper | 75 |
| Lead | 15 |
| Mercury | 0.85 |
| Molybdenum | Report |
| Nickel | 21 |
| Selenium | 5 |
| Zinc | 140 |

2. Pathogen Control

All sewage sludge that is sold or given away in a bag or other container for application to the land shall be treated by the Class A pathogen requirements as defined in Section I.B.3.a.

3. Management Practices

Either a label shall be affixed to the bag or other container in which sewage sludge that is sold or given away for application to the land, or an information sheet shall be provided to the person who receives sewage sludge sold or given away in an other container for application to the land. The label or information sheet shall contain the following information:

a. The name and address of the person who prepared the sewage sludge that is sold or given away in a bag or other container for application to the land.

b. A statement that application of the sewage sludge to the land is prohibited except in accordance with the instructions on the label or information sheet.

c. The annual whole sludge application rate for the sewage sludge that will not cause any of the annual pollutant loading rates in Table 4 above to be exceeded.

4. Notification Requirements - None.

5. Recordkeeping Requirements - The sludge documents will be retained on site at the same location as other NPDES records.

The person who prepares sewage sludge or a sewage sludge material shall develop the following information and shall retain the information for five years.

a. The concentration in the sludge of each pollutant listed above in found in Element I, Section I, Table 1.

b. The following certification statement found in 503.17(a)(6)(iii).

"I certify, under penalty of law, that the information that will be used to determine compliance with the management practices in §503.14(e), the Class A pathogen requirement in §503.32(a), and the vector attraction reduction requirement in (insert vector attraction reduction option) have been met. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine that the management practices, pathogen requirements, and vector attraction reduction requirements have been met. I am aware that there are significant penalties for false certification including the possibility of fine and imprisonment".

c. A description of how the Class A pathogen reduction requirements are met.

d. A description of how the vector attraction reduction requirements are met.

e. The annual whole sludge application rate for the sewage sludge that does not cause the annual pollutant loading rates in Table 4 to be exceeded. See Appendix A to Part 503 - Procedure to Determine the Annual Whole Sludge Application Rate for a Sewage Sludge.

6. Reporting Requirements - The permittee shall report annually on the DMR the following information:

a. List Pollutant Table 4 appropriate for permittee's land application practices.

b. The frequency of monitoring listed in Element 1, Section I.C. which applies to the permittee.

c. Toxicity Characteristic Leaching Procedure (TCLP) results (Pass/Fail).

d. The concentration (mg/Kg) in the sludge of each pollutant listed above in Table 1 (defined as a monthly average) found in Element 1, Section I.

e. Class A pathogen reduction Alternative used as listed in Section I.B.3.a. Alternatives describe how the pathogen reduction requirements are met.

f. Vector attraction reduction Alternative used as listed in Section I.B.4.

g. Annual sludge production in dry metric tons/year.

h. Amount of sludge land applied in dry metric tons/year.

i. Amount of sludge transported interstate in dry metric tons/year.

j. The following certification statement found in § 503.17(a)(6)(iii) shall be attached to the DMR.

"I certify, under penalty of law, that the information that will be used to determine compliance with the management practice in §503.14(e), the Class A pathogen requirement in §503.32(a), and the vector attraction reduction requirement (insert appropriate option) have been met. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel gather and evaluate the information used to determine that the management practice, pathogen requirements, and vector attraction reduction requirements have been met. I am aware that there are significant penalties for false certification including the possibility of fine and imprisonment."

## ELEMENT 2- SURFACE DISPOSAL

## SECTION I. REQUIREMENTS APPLYING TO ALL SEWAGE SLUDGE SURFACE DISPOSAL

### A. General Requirements

1. The permittee shall handle and dispose of sewage sludge in accordance with Section 405 of the Clean Water Act and all other applicable Federal regulations to protect public health and the environment from any reasonably anticipated adverse effects due to any toxic pollutants which may be present.

2. If requirements for sludge management practices or pollutant criteria become more stringent than the sludge pollutant limits or acceptable management practices in this permit, or control a pollutant not listed in this permit, this permit may be modified or revoked and reissued to conform to the requirements promulgated at Section 405(d)(2) of the Clean Water Act.

3. In all cases, if the person (permit holder) who prepares the sewage sludge supplies the sewage sludge to another person (owner or operator of a sewage sludge unit) for disposal in a surface disposal site, the permit holder shall provide all necessary information to the parties who receive the sludge to assure compliance with these regulations.

4. The permittee shall give prior notice to EPA (Chief, Permits Branch, Water Management Division, Mail Code 6W-P, EPA Region 6, 1445 Ross Avenue, Dallas, Texas 75202) of any planned changes in the sewage sludge disposal practice, in accordance with 40 CFR Part 122.41(l)(1)(iii). These changes may justify the application of permit conditions that are different from or absent in the existing permit. Change in the sludge use or disposal practice may be cause for modification of the permit in accordance with 40 CFR Part 122.62(a)(1).

5. The permittee or owner/operator shall submit a written closure and post closure plan to the permitting authority 180 days prior to the closure date. The plan shall include the following information:

(a) A discussion of how the leachate collection system will be operated and maintained for three years after the surface disposal site closes if it has a liner and leachate collection system.

(b) A description of the system used to monitor continuously for methane gas in the air in any structures within the surface disposal site. The methane gas concentration shall not exceed 25% of the lower explosive limit for methane gas for three years after the sewage sludge unit closes. A description of the system used to monitor for methane gas in the air at the property line of the site shall be included. The methane gas concentration at the surface disposal site property line shall not exceed the lower explosive limit for methane gas for three years after the sewage sludge unit closes.

(c) A discussion of how public access to the surface disposal site will be restricted for three years after it closes.

**B. Management Practices**

1. An active sewage sludge unit located within 60 meters of a fault that has displacement in Holocene time shall close by March 22, 1994.

2. An active sewage sludge unit located in an unstable area shall close by March 22, 1994.

3. An active sewage sludge unit located in a wetland shall close by March 22, 1994.

4. Surface disposal shall not restrict the flow of the base 100-year flood.

5. The run-off collection system for an active sewage sludge unit shall have the capacity to handle run-off from a 25-year, 24-hour storm event.

6. A food crop, feed crop, or a fiber crop shall not be grown on a surface disposal site.

7. Animals shall not be grazed on a surface disposal site.

8. Public access shall be restricted on the active surface disposal site and for three years after the site closes.

9. Placement of sewage sludge shall not contaminate an aquifer. This shall be demonstrated through one of the following:

   (a) Results of a ground-water monitoring program developed by a qualified ground-water scientist.

   (b) A certification by a qualified ground-water scientist may be used to demonstrate that sewage sludge placed on an active sewage sludge unit does not contaminate an aquifer.

10. When a cover is placed on an active surface disposal site, the concentration of methane gas in air in any structure within the surface disposal site shall not exceed 25 percent of the lower explosive limit for methane gas during the period that the sewage sludge unit is active. The concentration of methane gas in air at the property line of the surface disposal site shall not exceed the lower explosive limit for methane gas during the period that the sewage sludge unit is active. Monitoring shall be continuous.

**C. Testing Requirements**

1. Sewage sludge shall be tested once during the life of the permit within one year from the effective date of the permit in accordance with the method specified at 40 CFR 268, Appendix I (Toxicity Characteristic Leaching Procedure (TCLP)) or other approved methods. Sludge shall be tested after final treatment prior to leaving the POTW site. Sewage sludge determined to be a hazardous waste in accordance with 40 CFR Part 261, shall be handled according to RCRA standards for the disposal of hazardous waste in accordance with 40 CFR Part 262. The disposal of sewage sludge determined to be a hazardous waste, in other than a certified hazardous waste disposal facility shall be prohibited. The Information Management Section, telephone no. (214) 665-6750, and the appropriate state agency shall be notified of test failure within 24 hours. A written report shall be provided to this office within 7 days after failing the TCLP. The report will contain test results, certification that unauthorized disposal has not occurred and a summary of alternative disposal plans that comply with

RCRA standards for the disposal of hazardous waste. The report shall be addressed to: Director, Multimedia Planning and Permitting Division, EPA Region 6, Mail Code 6PD, 1445 Ross Avenue, Dallas, Texas 75202. A copy of this report shall be sent to the Chief, Water Enforcement Branch, Compliance Assurance and Enforcement Division, Mail Code 6EN-W, at the same street address.

2. Sewage sludge shall be tested at the frequency show below in Element 2, Section I.D. for PCBs. Any sludge exceeding a concentration of 50 mg/Kg shall not be surface disposed.

3. Pathogen Control

All sewage sludge that is disposed of in a surface disposal site shall be treated by either the Class A or Class B pathogen requirements unless sewage sludge is placed on an active surface disposal site and is covered with soil or other material at the end of each operating day. When reporting on the DMR, list pathogen reduction level attained as A, B, or C (daily cover). When reporting how compliance was met, list Alternative 1, 2, 3, 4, 5 or 6 for Class A, or Alternative Number 1, 2, 3, or 4 for Class B, on DMR.

(a) Six alternatives are available to demonstrate compliance with Class A sewage sludge. All 6 alternatives require either the density of fecal coliform in the sewage sludge be less than 1000 MPN per gram of total solids (dry weight basis), or the density of Salmonella sp. bacteria in the sewage sludge be less than three Most Probable Number per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed; at the time the sewage sludge is prepared for sale or given away in a bag or other container for application to the land. Below are the additional requirements necessary to meet the definition of a Class A sludge. Alternatives 5 and 6 are not authorized to demonstrate compliance with Class A sewage sludge in Texas permits.

Alternative 1 - The temperature of the sewage sludge that is used or disposed shall be maintained at a specific value for a period of time. See 503.32(a)(3)(ii) for specific information. This alternative is not applicable to composting

Alternative 2 - The pH of the sewage sludge that is used or disposed shall be raised to above 12 and shall remain above 12 for 72 hours. The pH shall be defined as the logarithm of the reciprocal of the hydrogen ion concentration measured at 25°C or measured at another temperature and then converted to an equivalent value at 25°C.

The temperature of the sewage sludge shall be above 52 degrees Celsius for 12 hours or longer during the period that the pH of the sewage sludge is above 12.

At the end of the 72 hour period during which the pH of the sewage sludge is above 12, the sewage sludge shall be air dried to achieve a percent solids in the sewage sludge greater than 50 percent.

Alternative 3 - The sewage sludge shall be analyzed for enteric viruses prior to pathogen treatment. The limit for enteric viruses is one Plaque-forming Unit per four grams of total solids (dry weight basis) either before or following pathogen treatment. See 503.32(a)(5)(ii) for specific information. The sewage sludge shall be analyzed for viable helminth ova prior to pathogen treatment. The limit for viable helminth ova is less than one per four grams of total solids (dry weight basis) either before or following pathogen treatment. See 503.32(a)(5)(iii) for specific information.

Alternative 4 - The density of enteric viruses in the sewage sludge shall be less than one Plaque-forming Unit per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed or at the time the sludge is prepared for sale or give away in a bag or other container for application to the land.

The density of viable helminth ova in the sewage sludge shall be less than one per four grams of total solids (dry weight basis) at the time the sewage sludge is used or disposed or at the time the sewage sludge is prepared for sale or give away in a bag or other container for application to the land.

Alternative 5 - Sewage sludge shall be treated by one of the Processes to Further Reduce Pathogens (PFRP) described in 503 Appendix B. PFRPs include composting, heat drying, heat treatment, and thermophilic aerobic digestion.

Alternative 6 - Sewage sludge shall be treated by a process that is equivalent to a Process to Further Reduce Pathogens, if individually approved by the Pathogen Equivalency Committee representing the EPA.

(b) Four alternatives are available to demonstrate compliance with Class B sewage sludge. Alternatives 2, 3, and 4 are not authorized to demonstrate compliance with Class B sewage sludge in Texas permits.

Alternative 1 - (i) Seven representative samples of the sewage sludge that is disposed shall be collected for one monitoring episode at the time the sewage sludge is used or disposed.

(ii) The geometric mean of the density of fecal coliform in the samples collected shall be less than either 2,000,000 Most Probable Number per gram of total solids (dry weight basis) or 2,000,000 Colony Forming Units per gram of total solids (dry weight basis).

Alternative 2 - Sewage sludge shall be treated in one of the Processes to significantly Reduce Pathogens described in 503 Appendix B.

Alternative 3 - Sewage sludge shall be treated in a process that is equivalent to a PSRP, if individually approved by the Pathogen Equivalency Committee representing the EPA.

Alternative 4 - Sewage sludge placed on an active surface disposal site is covered with soil or other material at the end of each operating day.

4. Vector Attraction Reduction Requirements

All sewage sludge that is disposed of in a surface disposal site shall be treated by one of the following alternatives 1 through 11 for Vector Attraction Reduction.

Alternative 1 - The mass of volatile solids in the sewage sludge shall be reduced by a minimum of 38 percent.

Alternative 2 - If Alternative 1 cannot be met for an anaerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge anaerobically in the laboratory in a bench-scale unit for 40 additional days at a temperature between 30 and 37 degrees Celsius. Volatile solids must be reduced by less than 17 percent to demonstrate compliance.

Alternative 3 - If Alternative 1 cannot be met for an aerobically digested sludge, demonstration can be made by digesting a portion of the previously digested sludge with a percent solids of two percent or less aerobically in the laboratory in a bench-scale unit for 30 additional days at 20 degrees Celsius. Volatile solids must be reduced by less than 15 percent to demonstrate compliance.

Alternative 4 - The specific oxygen uptake rate (SOUR) for sewage sludge treated in an aerobic process shall be equal to or less than 1.5 milligrams of oxygen per hour per gram of total solids (dry weight basis) at a temperature of 20 degrees Celsius.

Alternative 5 - Sewage sludge shall be treated in an aerobic process for 14 days or longer. During that time, the temperature of the sewage sludge shall be higher than 40 degrees Celsius and the average temperature of the sewage sludge shall be higher than 45 degrees Celsius.

Alternative 6 - The pH of sewage sludge shall be raised to 12 or higher by alkali addition and, without the addition of more alkali shall remain at 12 or higher for two hours and then at 11.5 or higher for an additional 22 hours at the time the sewage sludge is disposed.

Alternative 7 - The percent solids of sewage sludge that does not contain unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 75 percent based on the moisture content and total solids prior to mixing with other materials. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or an anaerobic treatment process at the time the sewage sludge is disposed.

Alternative 8 - The percent solids of sewage sludge that contains unstabilized solids generated in a primary wastewater treatment process shall be equal to or greater than 90 percent based on the moisture content and total solids prior to mixing with other materials at the time the sewage sludge is disposed. Unstabilized solids are defined as organic materials in sewage sludge that have not been treated in either an aerobic or an anaerobic treatment process.

Alternative 9 -
(i) Sewage sludge shall be injected below the surface of the land.

(ii) No significant amount of the sewage sludge shall be present on the land surface within one hour after the sewage sludge is injected.

(iii) When sewage sludge that is injected below the surface of the land is Class A with respect to pathogens, the sewage sludge shall be injected below the land surface within eight hours after being discharged from the pathogen treatment process.

Alternative 10 -
(i) Sewage sludge applied to the land surface or placed on a surface disposal site shall be incorporated into the soil within six hours after application to or placement on the land.

(ii) When sewage sludge that is incorporated into the soil is Class A with respect to pathogens, the sewage sludge shall be applied to or placed on the land within eight hours after being discharged from the pathogen treatment process.

Alternative 11 - Sewage sludge placed on an active sewage sludge unit shall be covered with soil or other material at the end of each operating day.

5. Methane Gas Control Within a Structure On Site

When cover is placed on an active surface disposal site, the methane gas concentration in the air in any structure shall not exceed 25% of the lower explosive limit (LEL) for methane gas during the period that the disposal site is active.

6. Methane Gas Control at Property Line

The concentration of methane gas in air at the property line of the surface disposal site shall not exceed the LEL for methane gas during the period that the disposal site is active.

## D. Monitoring Requirements

Toxicity Characteristic Leaching Procedure (TCLP) Test - Once/Permit Life, performed within one year from the effective date of the permit

PCBs - Once/Year

Methane Gas in covered structures on site - Continuous

Methane Gas at property line - Continuous

All other pollutants shall be monitored at the frequency shown below:

| Amount of sewage sludge* (metric tons per 365 day period) | Frequency |
|---|---|
| 0 ≤ Sludge < 290 | Once/Year |
| 290 ≤ Sludge < 1,500 | Once/Quarter |
| 1,500 ≤ Sludge < 15,000 | Once/Two Months |
| 15,000 ≤ Sludge | Once/Month |

* Amount of sewage sludge placed on an active sewage sludge unit (dry weight basis).

Representative samples of sewage sludge shall be collected and analyzed in accordance with the methods referenced in 40 CFR 503.8(b).

SECTION II. REQUIREMENTS SPECIFIC TO SURFACE DISPOSAL SITES WITHOUT A LINER AND LEACHATE COLLECTION SYSTEM.

1. Pollutant limits - Sewage sludge shall not be applied to a surface disposal site if the concentration of the listed pollutants exceed the corresponding values based on the surface disposal site boundary to the property line distance:

TABLE 5

| Unit boundary to property line distance (meters) | Pollutant Concentrations* | | | |
|---|---|---|---|---|
| | Arsenic (mg/kg) | Chromium (mg/kg) | Nickel (mg/kg) | PCB's (mg/kg) |
| 0 to less than 25 | 30 | 200 | 210 | 49 |
| 25 to less than 50 | 34 | 220 | 240 | 49 |
| 50 to less than 75 | 39 | 260 | 270 | 49 |
| 75 to less than 100 | 46 | 300 | 320 | 49 |
| 100 to less than 125 | 53 | 360 | 390 | 49 |
| 125 to less than 150 | 62 | 450 | 420 | 49 |
| ≥ 150 | 73 | 600 | 420 | 49 |

* Dry weight basis

2. Management practices - Listed in Section I.B. above.

3. Notification requirements -

   a. The permittee shall assure that the owner of the surface disposal site provide written notification to the subsequent site owners that sewage sludge was placed on the land.

   b. The permittee shall provide the location of all new sludge disposal/use sites where previously undisturbed ground is proposed for disturbance to the State Historical Commission within 90 days of the effective date of this permit. In addition, the permittee shall provide the location of any new disposal/use site to the State Historical Commission prior to use of the site.

      The permittee shall within 30 days after notification by the State Historical Commission that a specific sludge disposal/use area will adversely affect a National Historic Site, cease use of such area.

4. Recordkeeping requirements - The permittee shall develop the following information and shall retain the information for five years. The sludge documents will be retained on site at the same location as other NPDES records.

   a. The distance of the surface disposal site from the property line and the concentration (mg/Kg) in the sludge of each pollutant listed above in Table 5, as well as the applicable pollutant concentration criteria listed in Table 5.

   b. A certification statement that all applicable requirements (specifically listed) have been met, and that the permittee understands that there are significant penalties for false certification including fine and imprisonment. See 503.27(a)(1)(ii) or 503.27(a)(2)(ii) as applicable to the permittees sludge disposal activities.

   c. A description of how either the Class A or Class B pathogen reduction requirements are met, or whether sewage sludge placed on a surface disposal site is covered with soil or other material at the end of each operating day.

   d. A description of how the vector attraction reduction requirements are met.

   e. Results of a groundwater monitoring program developed by a qualified ground-water scientist, or a certification by a qualified groundwater scientist may be used to demonstrate that sewage sludge placed on an active sewage sludge unit does not contaminate an aquifer. A qualified groundwater scientist is an individual with a baccalaureate or post graduate degree in the natural sciences or engineering who has sufficient training and experience in groundwater hydrology and related fields, as may be demonstrated by State registration, professional certification or completion of accredited university programs, to make sound professional judgements regarding groundwater monitoring, pollutant fate and transport, and corrective action.

5. Reporting Requirements - The permittee shall report annually on the DMR the following information:

   a. Report <u>No</u> for no liner and leachate collection system at surface disposal site.

   b. The frequency of monitoring listed in Element II, Section I.D. which applies to the permittee.

   c. Toxicity Characteristic Leaching Procedure (TCLP) results (Pass/Fail).

   d. The concentration (mg/Kg) in the sludge of each pollutant listed in Table 5 as well as the applicable pollutant concentration criteria listed in Table 5.

   e. The concentration (mg/Kg) of PCB's in the sludge.

   f. The distance between the property line and the surface disposal site boundary.

g. Level of pathogen reduction achieved (Class A or Class B), unless Vector attraction reduction alternative no. 11 is utilized.

h. List Alternative used as listed in Section I.C.3.(a. or b.). Alternatives describe how the pathogen reduction requirements are met.

i. Vector attraction reduction Alternative used as listed in Section I.C.4.

j. Annual sludge production in dry metric tons/year.

k. Amount of sludge surface disposed in dry metric tons/year.

l. Amount of sludge transported interstate in dry metric tons/year.

m. A narrative description explaining how the management practices in §503.24 are met shall be attached to the DMR.

n. The certification statement listed in 503.27(a)(1)(ii) or 503.27(a)(2)(ii) as applicable to the permittees sludge disposal activities, shall be attached to the DMR.

## SECTION III. REQUIREMENTS SPECIFIC TO SURFACE DISPOSAL SITES WITH A LINER AND LEACHATE COLLECTION SYSTEM.

1. Pollutant limits - None.

2. Management Practices - Listed in Section I.B. above.

3. Notification requirements -

   a. The permittee shall assure that the owner of the surface disposal site provide written notification to the subsequent owner of the site that sewage sludge was placed on the land.

   b. The permittee shall provide the location of all new sludge disposal/use sites where previously undisturbed ground is proposed for disturbance to the State Historical Commission within 90 days of the effective date of this permit. In addition, the permittee shall provide the location of any new disposal/use site to the State Historical Commission prior to use of the site.

      The permittee shall within 30 days after notification by the State Historical Commission that a specific sludge disposal/use area will adversely affect a National Historic Site, cease use of such area.

4. Recordkeeping requirements - The permittee shall develop the following information and shall retain the information for five years. The sludge documents will be retained on site at the same location as other NPDES records.

   a. The following certification statement found in 503.27(a)(1)(ii):

      "I certify, under penalty of law, that the information that will be used to determine compliance with the pathogen requirements (define option used) and the vector attraction reduction requirements (define option used) have been met. This determination has been made under my direction and supervision in accordance with the system designed to ensure that qualified personnel properly gather and evaluate the information used to determine the (pathogen requirements and vector attraction reduction requirements, if appropriate) have been met. I am aware that there are significant penalties for false certification including the possibility of fine and imprisonment."

b. A description of how either the Class A or Class B pathogen reduction requirements are met or whether sewage sludge placed on a surface disposal site is covered with soil or other material at the end of each operating day.

c. A description of how the vector attraction reduction requirements are met.

d. Results of a ground-water monitoring program developed by a qualified ground-water scientist. A certification by a qualified ground-water scientist may be used to demonstrate that sewage sludge placed on an active sewage sludge unit does not contaminate an aquifer.

5. Reporting Requirements - The permittee shall report annually on the DMR the following information:

a. Report <u>YES</u> for liner and leachate collection system at surface disposal site.

b. The frequency of monitoring listed in Element 2, Section I.D. which applies to the permittee.

c. Toxicity Characteristic Leaching Procedure (TCLP) results (Pass/Fail).

d. The concentration (mg/Kg) in the sludge of PCBs.

e. Level of pathogen reduction achieved (Class <u>A</u> or Class <u>B</u>), unless Vector attraction reduction alternative no. 11 is used.

f. List Alternative used as listed in Section I.C.3.(a. or b.). Alternatives describe how the pathogen reduction requirements are met.

g. Vector attraction reduction Alternative used as listed in Section I.B.4.

h. Annual sludge production in dry metric tons/year.

i. Amount of sludge surface disposed in dry metric tons/year.

j. Amount of sludge transported interstate in dry metric tons/year.

k. A narrative description explaining how the management practices in §503.24 are met shall be attached to the DMR.

l. A certification statement that all applicable requirements (specifically listed) have been met, and that the permittee understands that there are significant penalties for false certification including fine and imprisonment (See 503.27(a)(1)(ii) or 503.27(a)(2)(ii) whichever applies to the permittees sludge disposal activities) shall be attached to the DMR.

## ELEMENT 3 - MUNICIPAL SOLID WASTE LANDFILL DISPOSAL

### SECTION I. <u>REQUIREMENTS APPLYING TO ALL SEWAGE SLUDGE DISPOSED IN A MUNICIPAL SOLID WASTE LANDFILL</u>

1. The permittee shall handle and dispose of sewage sludge in accordance with Section 405 of the Clean Water Act and all other applicable Federal regulations to protect public health and the environment from any reasonably anticipated adverse effects due to any toxic pollutants that may be present. The permittee shall ensure that the sewage sludge meets the requirements in 40 CFR 258 concerning the quality of the sludge disposed in the municipal solid waste landfill unit.

2. If requirements for sludge management practices or pollutant criteria become more stringent than the sludge pollutant limits or acceptable management practices in this permit, or control a pollutant not listed in this permit, this permit may be modified or revoked and reissued to conform to the requirements promulgated at Section 405(d)(2) of the Clean Water Act.

3. If the permittee generates sewage sludge and supplies that sewage sludge to the owner or operator of a MSWLF for disposal, the permittee shall provide to the owner or operator of the MSWLF appropriate information needed to be in compliance with the provisions of this permit.

4. The permittee shall give prior notice to EPA (Chief, Permits Branch, Water Management Division, Mail Code 6W-P, EPA Region 6, 1445 Ross Avenue, Dallas, Texas 75202) of any planned changes in the sewage sludge disposal practice, in accordance with 40 CFR Part 122.41(l)(1)(iii). These changes may justify the application of permit conditions that are different from or absent in the existing permit. Change in the sludge use or disposal practice may be cause for modification of the permit in accordance with 40 CFR Part 122.62(a)(1).

5. The permittee shall provide the location of all new sludge disposal/use sites where previously undisturbed ground is proposed for disturbance to the State Historical Commission within 90 days of the effective date of this permit. In addition, the permittee shall provide the location of any new disposal/use site to the State Historical Commission prior to use of the site.

   The permittee shall within 30 days after notification by the State Historical Commission that a specific sludge disposal/use area will adversely affect a National Historic Site, cease use of such area.

6. Sewage sludge shall be tested once during the life of the permit within one year from the effective date of the permit in accordance with the method specified at 40 CFR 268, Appendix I (Toxicity Characteristic Leaching Procedure (TCLP)) or other approved methods. Sludge shall be tested after final treatment prior to leaving the POTW site. Sewage sludge determined to be a hazardous waste in accordance with 40 CFR Part 261, shall be handled according to RCRA standards for the disposal of hazardous waste in accordance with 40 CFR Part 262. The disposal of sewage sludge determined to be a hazardous waste, in other than a certified hazardous waste disposal facility shall be prohibited. The Information Management Section, telephone no. (214) 665-6750, and the appropriate state agency shall be notified of test failure within 24 hours. A written report shall be provided to this office within 7 days after failing the TCLP. The report will contain test results, certification that unauthorized disposal has not occurred and a summary of alternative disposal plans that comply with RCRA standards for the disposal of hazardous waste. The report shall be addressed to: Director, Multimedia Planning and Permitting Division, EPA Region 6, Mail Code 6PD, 1445 Ross Avenue, Dallas, Texas 75202. A copy of this report shall be sent to the Chief, Water Enforcement Branch, Compliance Assurance and Enforcement Division, Mail Code 6EN-W, at the same street address.

7. Sewage sludge shall be tested as needed, or at a minimum, once/year in accordance with the method 9095 (Paint Filter Liquids Test) as described in "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods" (EPA Pub. No. SW-846).

8. Recordkeeping requirements - The permittee shall develop the following information and shall retain the information for five years.

   a. The description, including procedures followed, and results of the Paint Filter Tests performed.

   b. The description, including procedures followed, and results of the TCLP Test.

9. Reporting requirements - The permittee shall report annually on the Discharge Monitoring Report the following information:

   a. Results of the Toxicity Characteristic Leaching Procedure Test conducted on the sludge to be disposed (Pass/Fail).

   b. Annual sludge production in dry metric tons/year.

c. Amount of sludge disposed in a municipal solid waste landfill in dry metric tons/year.

d. Amount of sludge transported interstate in dry metric tons/year.

e. A certification that sewage sludge meets the requirements in 40 CFR 258 concerning the quality of the sludge disposed in a municipal solid waste landfill unit shall be attached to the DMR.

# APPENDIX C

# CALCULATIONS

**Objective**

**Determine aerobic, anoxic, and anaerobic residence time for a single-sludge BNR system.**

METCALF & EDDY METHOD FOR NITRIFICATION/DE-NITRIFICATION
Based on the Fourth Edition
NOTE: This is sometimes called the IWA Procedure
or the IAWPRC ASM 1 Model

**Ruidoso @ 10C**

Refer to Chapters 7 & 8 of Metcalf & Eddy

Typical Design For Secondary Clarifiers For the Activated Sludge Process
Settling Following air activated sludge (excluding Extended Aeration)
Avg. Overflow Rate is 400 to 700 gpd/SF & Peak Overflow Rate is 1000 to 1600 gpd/SF
Solids Loading Rate is 19 to 29 lbs./SF/Day avg. & peak at 38 lbs./SF/Day
Settling Following Extended Aeration
Avg. Overflow Rate is 200 to 400 gpd/SF & Peak Overflow Rate is 600 to 800 gpd/SF
Solids Loading Rate is 5 to 24 lbs./SF/Day avg. & peak at 34 lbs./SF/Day
Settling For Phosphorous Removal:
Effluent Conc., mg/l (Based on Phosphorous removal Efficiency)
Total P = 2 600 to 800 gpd/SF
Total P = 1 400 to 600 gpd/SF
Total P = 0.2 to 0.5 300 to 500 gpd/SF

The Activated Sludge Nitrification Kinetic Coefficients at 20 degrees, C are as follows (Table 8-11)

| Coefficient | Unit | Range | Typical Value |
|---|---|---|---|
| Umn | mg VSS/mg VSS-d | 0.20 to 0.90 | 0.75 |
| Kn | mg Ammonia Nit./l | 0.50 to 1.0 | 0.74 |
| Yn | mg VSS/mg Ammonia Nit. | 0.10 to 0.15 | 0.12 |
| Kdn | mg VSS/mg VSS-d | 0.05 to 0.15 | 0.08 |
| Ko | mg/l | 0.40 to 0.60 | 0.5 |
| Theta Values | | | |
| Un | unitless | 1.06 to 1.123 | 1.07 |
| Kn | unitless | 1.03 to 1.123 | 1.053 |
| k(dn) | unitless | 1.03 to 1.08 | 1.04 |

The design procedure is shown in Metcalf & Eddy in Chapter 7, & Sections 8-2 & 8-3

Step 1. Obtain the Influent Waste Characterization Data (By test or Calc.):
Design using Complete Mix or Plug Flow Design for BOD Removal with Nitrification

| | | |
|---|---|---|
| Influent BOD in cell (F41) | 325 | mg/l |
| Average Daily Flow in cell (F42) is | 2.5 | MGD |
| influent TKN in cell (F43) | 50 | mg/l |
| Operating Temperature, deg. C is cell (F44) | 10 | degrees,C |
| Effluent Ammonia is in cell (F45) (N) | 1 | mg/l |
| Effluent TKN is in cell (F46) | 10 | mg/l |
| sBOD is estimated at 0.5 times BOD | 162.5 | mg/l |
| COD is estimated at | 520 | mg/l |

| | | | | |
|---|---|---|---|---|
| COD to BOD Ratio: | | | 1.6 | Estimate for rural New Mexico |
| Untreated | 1.3 | to | 3.3 | Typical from literature |
| After Primary Settling | 1.7 | to | 2.5 | Typical from literature |
| Final Effluent | 3.3 | to | 10 | Typical from literature |
| sCOD is estimated at | | | 229 mg/l | |
| rbCOD is estimated at | | | 133 mg/l | |
| TSS/BOD estimated at | | | 1.11 | |
| TSS is therefore | | | 362 mg/l | |
| VSS/TSS is estimated at | | | 0.85 | |
| VSS is therefore | | | 307 mg/l | |
| Ammonia Nit. Is estimated at | | | 30 mg/l | |
| bCOD/BOD ratio | | | 1.3 | |
| D.O in Aeration Basin is estimated at | | | 2 mg/l | |
| VSS is estimated at cell(F60) or use 0.45 * (F41) alt. | | | ***307*** mg/l | |
| bCOD is estimated at | | | ***409*** mg/l | |

Use Kinetic Coefficients outlined above and/or in Table 8 -10 of M & E.

<u>This follows the procedure outlined on page 713 of the 4th Edition</u>

Step 1. Perform the Nitrification Design following the same steps as for BOD removal alone, except the design SRT must first be determined. Determine the specific growth rate,Un, for the nitrifying organisms. The Nitrifying Organisms grow more slowly than the Heterotrophic Organisms that remove organic carbon.

Use the formula:

Un = ( (Unm * N)/ (Kn + N)) * (DO/(Ko + DO)) - k(dn)

a. Find Unm at T listed above:

Use the Formula Unm at T = 0.75 * 1.07^(T-20) — T - 20 equals ***-10***

1.07^(T-20) equals ***0.508349***

Unm at T equals ***0.381262*** mg/mg-d

b. Find Kn at T in cell (F44), above:

Use the formula Kn at T = 0.74 * 1.053^(T-20)

1.053^(T-20) equals ***0.596645***

Kn at T equals ***0.441518*** mg/l

c. Find Kdn at T in cel ll (F44)

Use the formula Kdn at T = 0.08 * 1.04^(T-20)

1.04^(T-20) equals ***0.675564***

Kdn at T equals ***0.054045*** mg/l

d. Substitute the above and given values in the equation below, and solve for Un:

Un = ((Umn * N)/(Kn + N))*(DO/(Ko + DO)) - Kdn

Un equals ***0.157544*** mg/mg-d

Step 2. Determine the Theoretical and Design SRT.

a. Find the theoretical SRT using the formula: SRT = 1/Un
   and,

SRT equals **_6.34743_** days

b. Determine the Design SRT by multiplying by the Safety Factor.

<u>Actual safety factor used or calculation is:</u> 2.0
The resulting SRT is: **_12.69486_** days

Step 3. Determine the Biomass Production
Use M & E Equation (8-15, p.682 of 4th Edition, parts A,B, & C)
Note: The formula gives an answer in kg-VSS/day of net waste activated sludge produced.
We can convert that answer to pounds by multiplying by 2.2046, as a conversion factor.
Ref. is also made to Fig. 8-7 (in M & E), p. 682, for values of observed solids yields.
M & E figures VSS at about 85 % of TSS

a. Part A. Determine Heterotrophic Biomass
(A) equals QY(So - S)(1kg/1000g)/(1 + Kd * SRT)
Everything in this equation is in metric, so let's define the input data, as listed below:
Q equals ADF in cu. Meters/day, divide Cell (F42) by 0.00026417
Q(cu. Mtrs./day equals cell (G131) **_9463.603_** cu.mtrs./day
Y equals observed yield, g VSS/g substrate removal, See Fig. 8-7, p. 682
For this calculation, that value is listed in cell (G133) **0.594665** g-VSS/g-BOD(rem)
To convert this to compatible numbers for bCOD, divide by cell (I134) **1.26**
That answer is in cell (F134), as **_0.471956_** gVSS/G bCOD
So equals the mg/l of bCOD, equals cell (F41) * cell (I134)
That answer is in cell (F137), as **_409.5_** mg/l, or g/cu. Mtr.
Now refer to Tables 8-10 and 8-11 in M & E, pp. 704 & 705
Note: Table 8-11 info is given above
Table 8-10 info is given below:

| Coefficient | Unit | Range | Typ. Value |
|---|---|---|---|
| Um | gVSS/gVSS-day | 3.0 - 13.2 | 6 |
| Ks | g bCOD/cu. Mtr. | 5.0 - 40.0 | 20 |
| Y | gVSS/g bCOD | 0.3 - 0.5 | 0.4 |
| k(d) | gVSS/gVSS-day | 0.06 - 0.2 | 0.12 |
| f(d) | Unitless | 0.08 - 0.2 | 0.15 |
| Theta Values | | | |
| Um | Unitless | 1.03 - 1.08 | 1.07 |
| k(d) | Unitless | 1.03 - 1.08 | 1.04 |
| Ks | Unitless | 1 | 1 |

Now calculate the value k(d,T) equals k(20)*Theta^(T-20), & put that value in cell (B153).
**_0.081068_** g/g-day
Now calculate the value Um equals Um(20)*Theta^(T-20), & put that value in cell (B155).
**_3.050096_** g/g-day
Now determine the value S (from Eq. 7-40 in Table 8-5, p. 679 of M & E, 4th Ed.).
S equals Ks(1 + k(d)* SRT)/SRT((Um - k(d) - 1) & put that value in cell (B158)
**_1.106059_** g bCOD/cu. Mtr.
Yn from Table 8-11 is listed in cell (F159) 0.13 g VSS/g Nox
Now list k(dn)(T) as previously calculated in cell (D86). List that value in cell (B161)
**_0.054045_** g/g-day
Assume NOx equals 80% of the value of TKN as the Nitrogen balance cannot be done as yet. The error in assuming that the Nox equals 80 % (TKN) is small as the Nitrifier VSS yield is a small fraction of the total MLVSS concentration.
NOx equals 0.80 * cell (F43). List that value in cell (G165) **_40_** mg/l or g/cu. Mtr.
Substitute the appropriate values in the respective expressions and solve as indicated below:
(A) equals in cell (E167) **_898927.4_** & divide by 1,000 to get kg's in
cell (E168) **_898.9274_** kg/day

Now calculate the (B) value for the equation, which is the ***cell debris factor***, calculated as:
(B) equals ( f(d)*k(d)*Q*Y*(So - S)*SRT*(1 kg/1000g) )/(1 + k(d)*SRT)
(B) equals in cell (E172) **_138768.7_** & divide by 1,000 to get kg's in
cell (E173) **_138.7687_** kg/day

Now calculate the © value for the equation, which is the ***Nitrifying Bacteria Biomass,*** and is calculated as:
( C ) equals (Q * Yn * NOx * (1 kg/1000g))/(1 +k(dn) * SRT),
Where: NOx is the concentration of Ammonia Nitrogen in the influent flow that is Nitrified, mg/l
k(dn) is the endogenous decay coefficient for Nitrifying Organisms, mg VSS/mg VSS-day
( C ) equals in cell (E180) **_29186.21_** & divide by 1,000 to get kg's in
cell (E181) **_29.18621_** kg/day

NOTE: In calculating the overall net waste Activated Sludge produced per day, a 4th factor called the *Nonbiodegradable VSS in the Influent, is also calculated, however, it is not* factored into these calculations. That factor equals Q * nbVSS * (1kg/1000 g). The total mass of dry solids wasted per day includes TSS and not just VSS. The TSS includes the VSS plus inorganic solids. Inorganic solids in the influent wastewater (TSSo - VSSo) contribute to inorganic solids & are an additional solids production term that must be added to Eqn. 8-15. The biomass terms in Eqn. 8-15 (A,B, & C) contain inorganic solids & the VSS fraction of the total biomass is about 0.85, based on the cell composition given in Table 7-4 (M & E). Thus, Eq. 8-15 is modified as follows to calculate the solids production in terms of TSS:

P(x,TSS) equals (A/0.85) + (B/0.85) + (C/0.85) + D + Q(TSSo - VSSo), Where:
TSSo is the influent wastewater TSS concentration, mg/l
VSSo is the influent wastewater VSS concentration, mg/l
The last term constitutes the Inert TSS in the influent factor. Typ. Aeration MLSS values range from 1200 to 4000 mg/l, but must be compatible with the *Clarifier Design.*

Now go back and add the three (3) values calculated above to get a total for P(x,bio).
P(x,bio) is calculated and listed in cell (B201) as the total of cells (E168),(E173) & (E181), as
**_1066.882_** kg VSS/day or equals **_2352.049_** dry lbs./day

Step 4. Determine the amount of Nitrogen oxidized to Nitrate. The amount of Nitrogen oxidized to Nitrate can be found by performing a *Nitrogen Balance*, using Eqn. 8-18 (M & E, p.684).

NOx equals TKN - Ne - 0.12 P(x,bio)/Q

NOx equals in cell (D207) ***35.47176*** mg/l or g/cu. Mtr.

Step 5. Determine the concentration and mass of VSS and TSS in the Aeration Basin.

Mass equals P(x)(SRT)

a. Calculate the concentration of VSS and TSS in the *Aeration Basin*

i. P(x,vss), Use M & E Eqn. (8-15). Parts A,B, & C have been calculated above as P(x,bio).
Part D must be added, as discussed above, to determine P(x,vss).
P(x,vss) equals P(x,bio) plus Q * (nbVSS) * (1kg/1000g)
Find nbVSS using Eqn. 8-3 & 8-4 from M & E,pp 672 & 673.

nbVSS equals (1 - (bpCOD/pCOD)) * VSS, and
bpCOD/pCOD = (bCOD/BOD) * (BOD - sBOD)/COD - sCOD

Where: bpCOD is the concentration of biodegradable particulate COD, mg/l
pCOD is the concentration of particulate COD, mg/l
sCOD is the concentration of soluble COD in the Activated Sludge Effluent, mg/l

bCOD equals cell F58 * cell F41, equals, in cell (G221) ***409.5*** mg/l

Find the nbCOD, use Eqn. (8-7) in M & E

nbCOD equals COD - bCOD
nbCOD equals in cell (G224) ***110.5*** mg/l

Find the effluent sCODe ,(assumed to be nonbiodegradable):

***24.05*** mg/l

Now we can calculate the nbVSS using Eqn. (8-3) & (8-4) from M & E.

bpCOD/pCOD =((bCOD/BOD) * (BOD - sBOD))/(COD - sCOD)
bpCOD/pCOD equals in cell (G229) ***0.703125***

nbVSS equals (1 - ratio of bpCOD/pCOD) * VSS.

nbVSS equals in cell (G232) ***91.26596*** mg/l

Find the iTSS equals TSS - VSS, in cell (G233) ***54.25097*** mg/l

Now we can calculate the value for P(x,vss) equals P(x,bio) + Q * nbVSS

The value for P(x,vss) is calculated and listed in cell (H235), as ***1930.587*** kg/day
or, expressed in English units, the value will be in cell (H236)as ***4256.172*** lbs./day

b. Calculate the mass of VSS and TSS in the *Aeration Basin* using Eqs.(7-54) and 7-66, (all in M & E, 4th Edition).

Xvss * V equals P(x,vss)*SRT
Xvss times V equals the calculated value in cell (H241) ***24508.53*** kg.
and, in English terms is equal to a value at, in cell (H242) ***54031.51*** lbs.

Xtss * V equals P(x,tss) *SRT

To calculate P(x,tss) , use Eqn. (8-16), with the term E added to account for the influent TSS:

P(x,tss) equals P(x,bio) + Q * nbVSS + Q * (TSSo - VSSo)
P(x,tss) is calculated and listed in cell (H247), as ***2632.27*** kg/day
or, expressed in English terms is equal to the value in cell (H248) ***5803.103*** lbs./day USE

Now we can calculate the mass of MLSS in the Aeration Basin, as follows:

Xtss * V equals P(x,tss) * SRT
and, Xtss times V equals the value calculated and listed in cell (H252) ***33416.3*** kg
or, expressed in English terms is equal to the value in cell (H253) ***73669.57*** lbs.

Step 6. Select a _Design MLSS Concentration_ and determine the *Aeration Tank Volume* and Detention Time.

a. We calculated the value of V * Xtss (above) as listed in cell (H252) at ***33416.3*** kg

Now let's try an MLSS value as listed in cell (H260) as 4000 mg/l

In basin, MLVSS/MLSS = **0.73343**

(which would give a rough value for MLVSS in cell (H262) as **2934** mg/l

Now we can calculate the volume, as follows:

Volume equals (Xtss * V) * 1,000/MLSS conc.

The volume is calculated and listed in cell (H267), as ***8354.075*** cu. Mtrs.

or, expressed in English terms is equal to the value in cell (H268) ***295021.7*** cubic feet

or, expressed in English terms is equal to the value in cell (H269) ***2206762*** gallons

b. Determine the Aeration Tank Detention Time

Use the formula D.T. equals V/Q

Detention Time is calculated and listed in cell (H273) ***21.1862*** hours

c. Determine the actual calculated MLVSS value:

Fraction VSS equals (Xvss * V/Xtss * V), calc. & list in cell (H276) ***0.73343***

and,

MLVSS is equal to the value calculated and listed in cell (H278) ***2933.722*** mg/l

Now let's go back and re-calculate a couple of numbers using an alternative MLSS number, which we will list in cell (G281), as 4000 mg/l

Re-calculating the volume and listing in cell (G282), we get: ***8354.075*** cubic meters

or, in English terms, we get a calculated value at cell (G282) ***295021.7*** cubic feet

or in (gallons), we get ***2206762*** gallons

This gives us a net difference at (G284 - H269),gallons ***0*** gallons

Also, the Detention Time will change to: ***21.1862*** hours

Step 7. Determine F/M and BOD Volumetric Loading USING ORIGINAL VOLUME

a. Determine F/M Using M & E, Eqn. (7-60)

F/M equals Q * So/XV. This value is calc. & listed in cell (H292) ***0.125494*** g/g-day or lbs/lb-day lbs/lb-day

b. Determine the volumetric BOD Loading, using M & E Eqn. (7-61)

L(org) equals Q * So/V

This value is calculated and listed in cell (H296) ***0.368164*** kg/cu.mtr.-day

and, converting to English terms, if we multiply by 62.427, we get a BOD loading at ***22.98338*** lbs. per thousand cubic feet per day.

Step 8. Determine the observed yield based on TSS and VSS

Observed yield equals g TSS/g bCOD

P(x,tss) equals what we calculated in cell (H247), listed in cell (H305) ***2632.27*** kg/day

and, bCOD removed equals Q *(So - S)
This value is calculated and listed in cell (H307) ***3864.878*** kg/day
Y(obs,tss) equals P(x,tss)/bCOD removed, and is calculated and
listed in cell (H309) ***0.681075***
kg TSS/kg bCOD or g TSS/g bCOD
or by multiplying by the value in cell (F58), we get the value
in cell (H312) as Observed yield based on TSS, equals ***0.858154***
g TSS/g BOD

Now calculate the observed yield based on VSS
VSS/TSS equals value in cell (H315), (calc. in line 275) ***0.73343***
Y(obs,tss) equals Obs. Yield based on TSS * (VSS/TSS), this
value is calculated and listed in cell (H317) ***0.499521***
g VSS/g bCOD

and, if we multiply by the value in cell F58, we get the following value
listed in cell (H320) ***0.629396***
g VSS/g BOD

Step 9. Estimate the Effluent BOD using M & E Eqn. (8-25), p.689
BOD equals sBODe + (g BOD/1.42 g VSS) * (0.85 g VSS/g TSS) * TSS
Assume effluent sBODe equals in cell (G325) 3 mg/l
Assume effluent TSS equals in cell (G326) 10 mg/l

BOD equals in cell (G328) ***8.9857*** mg/l
bCOD effluent is ***11.32198*** mg/l

Step 10. Secondary Clarifier Design
Check solids loading based on a recycle rate of Q, or a 1:1 recycle rate.
Solids loading equals lbs. TSS applied/S.F. of Clarifier area.
Keep under 15 lbs.per SF/day
MLSS was calculated above in cell (H260) & is ***4000*** mg/l

Area equals 2 * Q * MLSS * 8.34/15
Area is calculated and listed in cell (G337) ***11120*** SF

Step 11. Design a Pre-Anoxic Basin to go with the Nitrification Aeration Basin Calc. above.
Design for an effluent Nitrate level at (G340) 5 mg/l
Assume Nitrate concentration in RAS equals (G340) 5 mg/l
Assume mixing energy for Anoxic Reactor equals 10 kw/1000 cu. Mtrs.
Use Eqn. (7-43) and substitute V/Q for Tau
The Aerobic Detention Time was calculated and listed in cell (H272) as ***21.1862*** hours

Xb equals (Q * SRT/V) * (Y * (So - S)/1 + (k(d)) * SRT)
Where: So - S ~ So
The other data required are calculated or listed above, and are re-listed here for convenience.

| | | |
|---|---|---|
| T equals | ***10*** | degrees,C |
| Q equals | ***9463.603*** | cu. Mtrs./day |
| SRT (aerobic) equals | ***12.69486*** | days |
| V equals volume | ***8354.075*** | cu. Mtrs. |
| Y equals | ***0.471956*** | |
| k(d)(T) equals | ***0.081068*** | |
| BOD equals | ***325*** | mg/l |
| bCOD equals | ***409.5*** | mg/l |
| rbCOD equals | 133 | mg/l assumed value |
| NOx equals | ***35.47176*** | mg/l |

Tot. P equals (Estimated Value) 8 mg/l
MLSS equals ***4000*** mg/l
MLVSS equals ***2933.722*** mg/l
RAS equals 1 Q

Xb is Calculated and listed in cell (G362) ***1331.84*** g/cu. Mtr.

a. Determine the IR ratio using M & E, Eqn. (8-48)
Aerobic tank Nitrate Nitrogen concentration, Ne equals (G340) ***5*** mg/l

IR equals (NOx/Ne) - 1.0 - R
IR equals value calculated and listed in cell (H368) 5.094352
IR to use is 4.0

Note; This is the internal recycle ratio.

b. Determine the amount of Nitrate Nitrogen fed to the Anoxic Tank
Flowrate to the Anoxic Tank equals IR *Q* + *RQ*
Equals the value calculated and listed in cell (H374) ***47318.01*** cu. Mtrs./day

NOx feed equals value in cell (H374) * value in cell (G340)
NOx feed equals value calculated and listed in cell (H377) ***236590.1*** g/day

c. Determine the ANOXIC VOLUME
As a first approximation use an estimated detention time
at (listed in cell (E382), hours 8 hours

Tau equals value in cell (E382)/24, calc. & listed in cell (H384) ***0.333333*** days

Vnox equals Tau * Q
Vnox equals value in cell (H384) * value in cell (F349), which is calculated
and listed in cell (G388) ***3154.534*** cu. Mtrs.

d. Determine F/Mb using M & E Eqn. (8-43)
F/Mb equals Q * So/Vnox * Xb
F/Mb equals the value calculated and listed in cell (H392) ***0.73207*** g/g-day

e. Determine the simultaneous Denitrification Rate using the curve in M & E p 755

Fraction of rbCOD equals rbCOD/bCOD which is calculated and listed
in cell (G398) ***0.3256***
equals ***32.56003*** %

From Figure 8-23, the SDNRb equals about (cell (H401)) **0.168** g/g-day @ 20,C

Apply the temperature correction factor using M & E Eqn. (8-44)
SDNR(T) equals value in cell H401 * 1.026^(T-20)
SDNR(T) is calculated and listed in cell (H405) ***0.130107*** g/g-day

f. Determine the amount of Nitrate- Nitrogen that can be reduced using M & E Eqn. (8-41)

Check NOr based on Tau equals value in cell (E382), hours

Tau equals value in cell (G410) ***8*** hours

NOr equals Vnox * SDNR * MLVSS, biomass

NOr equals value in cell (G388) * value in cell (H405) * value in cell (G362)

NOr equals the value calculated and listed in cell (H414) ***546622.6*** g/day

Comparing the value in cell (H414) with the value in cell (H377), we get, the following:

***236590.1*** versus ***546622.6***

Based on these numbers we have a net deficit of ***-310033*** g/day

NOTE: If the value in cell (F419) is positive, we have to go back and re-calculate.

| | |
|---|---|
| The sum of aerobic and anoxic detention times is: | ***29*** hours |

**Objective 1**

Calculate Yobs (VSS/BOD) value used in calculation of heterotrophic biomass. M&E Figure 8-7 has graphs for these figures. This worksheet uses curve fits to approximate the graphs.

| | | |
|---|---|---|
| T = | 10 | C |
| SRT = | 12.69486 | d |
| Primary? | 1 | Insert 1 if there is primary treatment<br>Insert 0 if there is no primary treatment |

| Primary | | No Primary | |
|---|---|---|---|
| Y = | 0.865838 | Y = | 1.182642 |
| kd = | 0.035921 | kd = | 0.027173 |
| Yobs = | 0.594665 | Yobs = | 0.879312 |

Yobs = 0.594665

Calculate Yobs (VSS/BOD) value used in calculation of heterotrophic biomass. M&E Figure 8-7 has graphs for these figures. This worksheet uses curve fits to approximate the graphs.

**Objective 2**

Calculate SDNR value used to size anoxic basin. Use Figure 8-23 to find SDNR at temperature.

F/Mb = 0.73207 g/g-day

| F/Mb Range | SDNR | |
|---|---|---|
| 0 to 2 | 0.168 | Inclusive |
| 2 to 20 | 0.225 | |

Use if statement

SDNR = 0.168

**Objective**

**Determine aerobic, anoxic, and anaerobic residence time for a single-sludge BNR system.**

METCALF & EDDY METHOD FOR NITRIFICATION/DE-NITRIFICATION
Based on the Fourth Edition
NOTE: This is sometimes called the IWA Procedure
or the IAWPRC ASM 1 Model

**Ruidoso @ 21C**

Refer to Chapters 7 & 8 of Metcalf & Eddy

Typical Design For Secondary Clarifiers For the Activated Sludge Process
Settling Following air activated sludge (excluding Extended Aeration)
Avg. Overflow Rate is 400 to 700 gpd/SF & Peak Overflow Rate is 1000 to 1600 gpd/SF
Solids Loading Rate is 19 to 29 lbs./SF/Day avg. & peak at 38 lbs./SF/Day
Settling Following Extended Aeration
Avg. Overflow Rate is 200 to 400 gpd/SF & Peak Overflow Rate is 600 to 800 gpd/SF
Solids Loading Rate is 5 to 24 lbs./SF/Day avg. & peak at 34 lbs./SF/Day
Settling For Phosphorous Removal:
Effluent Conc., mg/l (Based on Phosphorous removal Efficiency)
Total P = 2 600 to 800 gpd/SF
Total P = 1 400 to 600 gpd/SF
Total P = 0.2 to 0.5 300 to 500 gpd/SF

The Activated Sludge Nitrification Kinetic Coefficients at 20 degrees, C are as follows (Table 8-11)

| Coefficient | Unit | Range | Typical Value |
|---|---|---|---|
| Umn | mg VSS/mg VSS-d | 0.20 to 0.90 | 0.75 |
| Kn | mg Ammonia Nit./l | 0.50 to 1.0 | 0.74 |
| Yn | mg VSS/mg Ammonia Nit. | 0.10 to 0.15 | 0.12 |
| Kdn | mg VSS/mg VSS-d | 0.05 to 0.15 | 0.08 |
| Ko | mg/l | 0.40 to 0.60 | 0.5 |
| Theta Values | | | |
| Un | unitless | 1.06 to 1.123 | 1.07 |
| Kn | unitless | 1.03 to 1.123 | 1.053 |
| k(dn) | unitless | 1.03 to 1.08 | 1.04 |

The design procedure is shown in Metcalf & Eddy in Chapter 7, & Sections 8-2 & 8-3

Step 1. Obtain the Influent Waste Characterization Data (By test or Calc.):
Design using Complete Mix or Plug Flow Design for BOD Removal with Nitrification

| | | |
|---|---|---|
| Influent BOD in cell (F41) | 325 | mg/l |
| Average Daily Flow in cell (F42) is | 2.5 | MGD |
| influent TKN in cell (F43) | 50 | mg/l |
| Operating Temperature, deg. C is cell (F44) | 21 | degrees,C |
| Effluent Ammonia is in cell (F45) (N) | 1 | mg/l |
| Effluent TKN is in cell (F46) | 10 | mg/l |
| sBOD is estimated at 0.5 times BOD | 162.5 | mg/l |
| COD is estimated at | 520 | mg/l |

COD to BOD Ratio: 1.6 Estimate for rural New Mexico

| | | | | |
|---|---|---|---|---|
| Untreated | 1.3 | to | 3.3 | Typical from literature |
| After Primary Settling | 1.7 | to | 2.5 | Typical from literature |
| Final Effluent | 3.3 | to | 10 | Typical from literature |

sCOD is estimated at 229 mg/l
rbCOD is estimated at 133 mg/l
TSS/BOD estimated at 1.1
TSS is therefore 362 mg/l
VSS/TSS is estimated at 0.85
VSS is therefore 307 mg/l
Ammonia Nit. Is estimated at 30 mg/l
bCOD/BOD ratio 1.3
D.O in Aeration Basin is estimated at 2 mg/l
VSS is estimated at cell(F60) or use 0.45 * (F41) alt. ***307*** mg/l
bCOD is estimated at ***409*** mg/l

Use Kinetic Coefficients outlined above and/or in Table 8 -10 of M & E.

<u>This follows the procedure outlined on page 713 of the 4th Edition</u>

Step 1. Perform the Nitrification Design following the same steps as for BOD removal alone, except the design SRT must first be determined. Determine the specific growth rate,Un, for the nitrifying organisms. The Nitrifying Organisms grow more slowly than the Heterotrophic Organisms that remove organic carbon.

Use the formula:

Un = ( (Unm * N)/ (Kn + N)) * (DO/(Ko + DO)) - k(dn)

a. Find Unm at T listed above:
Use the Formula Unm at T = 0.75 * 1.07^(T-20) T - 20 equals ***1***
1.07^(T-20) equals ***1.07***
Unm at T equals ***0.8025*** mg/mg-d

b. Find Kn at T in cell (F44), above:
Use the formula Kn at T = 0.74 * 1.053^(T-20)
1.053^(T-20) equals ***1.053***
Kn at T equals ***0.77922*** mg/l

c. Find Kdn at T in cel ll (F44)
Use the formula Kdn at T = 0.08 * 1.04^(T-20)
1.04^(T-20) equals ***1.04***
Kdn at T equals ***0.0832*** mg/l

d. Substitute the above and given values in the equation below, and solve for Un:

Un = ((Umn * N)/(Kn + N))*(DO/(Ko + DO)) - Kdn
Un equals ***0.277632*** mg/mg-d

Step 2. Determine the Theoretical and Design SRT.

a. Find the theoretical SRT using the formula: SRT = 1/Un
and,

SRT equals **_3.601887_** days

Note: The M & E Method gives a more conservative number.

b. Determine the Design SRT by multiplying by the Safety Factor.

<u>Actual safety factor used or calculation is:</u> 2.0

The resulting SRT is: **_7.203773_** days

Step 3. Determine the Biomass Production

Use M & E Equation (8-15, p.682 of 4th Edition, parts A,B, & C)

Note: The formula gives an answer in kg-VSS/day of net waste activated sludge produced.
We can convert that answer to pounds by multiplying by 2.2046, as a conversion factor.
Ref. is also made to Fig. 8-7 (in M & E), p. 682, for values of observed solids yields.
M & E figures VSS at about 85 % of TSS

a. Part A. Determine Heterotrophic Biomass

(A) equals QY(So - S)(1kg/1000g)/(1 + Kd * SRT)

Everything in this equation is in metric, so let's define the input data, as listed below:

Q equals ADF in cu. Meters/day, divide Cell (F42) by 0.00026417

Q(cu. Mtrs./day equals cell (G131) **_9463.603_** cu.mtrs./day

Y equals observed yield, g VSS/g substrate removal, See Fig. 8-7, p. 682

For this calculation, that value is listed in cell (G133) **0.579385** g-VSS/g-BOD(rem)

To convert this to compatible numbers for bCOD, divide by cell (I134) **1.26**

That answer is in cell (F134), as **_0.459829_** gVSS/G bCOD

So equals the mg/l of bCOD, equals cell (F41) * cell (I134)

That answer is in cell (F137), as **_409.5_** mg/l, or g/cu. Mtr.

Now refer to Tables 8-10 and 8-11 in M & E, pp. 704 & 705

Note: Table 8-11 info is given above

Table 8-10 info is given below:

| Coefficient | Unit | Range | Typ. Value |
|---|---|---|---|
| Um | gVSS/gVSS-day | 3.0 - 13.2 | 6 |
| Ks | g bCOD/cu. Mtr. | 5.0 - 40.0 | 20 |
| Y | gVSS/g bCOD | 0.3 - 0.5 | 0.4 |
| k(d) | gVSS/gVSS-day | 0.06 - 0.2 | 0.12 |
| f(d) | Unitless | 0.08 - 0.2 | 0.15 |
| Theta Values | | | |
| Um | Unitless | 1.03 - 1.08 | 1.07 |
| k(d) | Unitless | 1.03 - 1.08 | 1.04 |
| Ks | Unitless | 1 | 1 |

Now calculate the value k(d,T) equals k(20)*Theta^(T-20), & put that value in cell (B153).

***0.1248*** g/g-day

Now calculate the value Um equals Um(20)*Theta^(T-20), & put that value in cell (B155).

***6.42*** g/g-day

Now determine the value S (from Eq. 7-40 in Table 8-5, p. 679 of M & E, 4th Ed.).

S equals Ks(1 + k(d)* SRT)/SRT((Um - k(d) - 1) & put that value in cell (B158)

***0.856399*** g bCOD/cu. Mtr.

Yn from Table 8-11 is listed in cell (F159) 0.14 g VSS/g Nox

Now list k(dn)(T) as previously calculated in cell (D86). List that value in cell (B161)

***0.0832*** g/g-day

Assume NOx equals 80% of the value of TKN as the Nitrogen balance cannot be done as yet. The error in assuming that the Nox equals 80 % (TKN) is small as the Nitrifier VSS yield is a small fraction of the total MLVSS concentration.

NOx equals 0.80 * cell (F43). List that value in cell (G165) ***40*** mg/l or g/cu. Mtr.

Substitute the appropriate values in the respective expressions and solve as indicated below:

(A) equals in cell (E167) ***936409.2*** & divide by 1,000 to get kg's in
cell (E168) ***936.4092*** kg/day

Now calculate the (B) value for the equation, which is the ***cell debris factor***, calculated as:

(B) equals ( f(d)*k(d)*Q*Y*(So - S)*SRT*(1 kg/1000g) )/(1 + k(d)*SRT)

(B) equals in cell (E172) ***126279.1*** & divide by 1,000 to get kg's in
cell (E173) ***126.2791*** kg/day

Now calculate the © value for the equation, which is the ***Nitrifying Bacteria Biomass,*** and is calculated as:

( C ) equals (Q * Yn * NOx * (1 kg/1000g))/(1 +k(dn) * SRT),

Where: NOx is the concentration of Ammonia Nitrogen in the influent flow that is Nitrified, mg/l
k(dn) is the endogenous decay coefficient for Nitrifying Organisms, mg VSS/mg VSS-day

( C ) equals in cell (E180) ***33135.99*** & divide by 1,000 to get kg's in
cell (E181) ***33.13599*** kg/day

NOTE: In calculating the overall net waste Activated Sludge produced per day, a 4th factor called the *Nonbiodegradable VSS in the Influent, is also calculated, however, it is not* factored into these calculations. That factor equals Q * nbVSS * (1kg/1000 g). The total mass of dry solids wasted per day includes TSS and not just VSS. The TSS includes the VSS plus inorganic solids. Inorganic solids in the influent wastewater (TSSo - VSSo) contribute to inorganic solids & are an additional solids production term that must be added to Eqn. 8-15. The biomass terms in Eqn. 8-15 (A,B, & C) contain inorganic solids & the VSS fraction of the total biomass is about 0.85, based on the cell composition given in Table 7-4 (M & E). Thus, Eq. 8-15 is modified as follows to calculate the solids production in terms of TSS:

P(x,TSS) equals (A/0.85) + (B/0.85) + (C/0.85) + D + Q(TSSo - VSSo), Where:
TSSo is the influent wastewater TSS concentration, mg/l
VSSo is the influent wastewater VSS concentration, mg/l
The last term constitutes the Inert TSS in the influent factor. Typ. Aeration MLSS values range from 1200 to 4000 mg/l, but must be compatible with the *Clarifier Design.*

Now go back and add the three (3) values calculated above to get a total for P(x,bio).
P(x,bio) is calculated and listed in cell (B201) as the total of cells (E168),(E173) & (E181), as

***1095.824*** kg VSS/day or equals ***2415.854*** dry lbs./day

Step 4. Determine the amount of Nitrogen oxidized to Nitrate. The amount of Nitrogen oxidized to Nitrate can be found by performing a <u>*Nitrogen Balance*</u>, using Eqn. 8-18 (M & E, p.684).

NOx equals TKN - Ne - 0.12 P(x,bio)/Q

NOx equals in cell (D207) ***35.10477*** mg/l or g/cu. Mtr.

Step 5. Determine the concentration and mass of VSS and TSS in the Aeration Basin.

Mass equals P(x)(SRT)

a. Calculate the concentration of VSS and TSS in the *Aeration Basin*

i. P(x,vss), Use M & E Eqn. (8-15). Parts A,B, & C have been calculated above as P(x,bio). Part D must be added, as discussed above, to determine P(x,vss).

P(x,vss) equals P(x,bio) plus Q * (nbVSS) * (1kg/1000g)

Find nbVSS using Eqn. 8-3 & 8-4 from M & E,pp 672 & 673.

nbVSS equals (1 - (bpCOD/pCOD)) * VSS, and

bpCOD/pCOD = (bCOD/BOD) * (BOD - sBOD)/COD - sCOD

Where: bpCOD is the concentration of biodegradable particulate COD, mg/l

pCOD is the concentration of particulate COD, mg/l

sCOD is the concentration of soluble COD in the Activated Sludge Effluent, mg/l

bCOD equals cell F58 * cell F41, equals, in cell (G221) ***409.5*** mg/l

Find the nbCOD, use Eqn. (8-7) in M & E

nbCOD equals COD - bCOD

nbCOD equals in cell (G224) ***110.5*** mg/l

Find the effluent sCODe ,(assumed to be nonbiodegradable):

***24.05*** mg/l

Now we can calculate the nbVSS using Eqn. (8-3) & (8-4) from M & E.

bpCOD/pCOD =((bCOD/BOD) * (BOD - sBOD))/(COD - sCOD)

bpCOD/pCOD equals in cell (G229) ***0.703125***

nbVSS equals (1 - ratio of bpCOD/pCOD) * VSS.

nbVSS equals in cell (G232) ***91.26596*** mg/l

Find the iTSS equals TSS - VSS, in cell (G233) ***54.25097*** mg/l

Now we can calculate the value for P(x,vss) equals P(x,bio) + Q * nbVSS

The value for P(x,vss) is calculated and listed in cell (H235), as ***1959.529*** kg/day

or, expressed in English units, the value will be in cell (H236)as ***4319.978*** lbs./day

b. Calculate the mass of VSS and TSS in the *Aeration Basin* using Eqs.(7-54) and 7-66, (all in M & E, 4th Edition).

Xvss * V equals P(x,vss)*SRT

Xvss times V equals the calculated value in cell (H241) ***14116*** kg.

and, in English terms is equal to a value at, in cell (H242) ***31120.14*** lbs.

Xtss * V equals P(x,tss) *SRT

To calculate P(x,tss) , use Eqn. (8-16), with the term E added to account for the influent TSS:

P(x,tss) equals P(x,bio) + Q * nbVSS + Q * (TSSo - VSSo)

P(x,tss) is calculated and listed in cell (H247), as ***2666.32*** kg/day

or, expressed in English terms is equal to the value in cell (H248) ***5878.168*** lbs./day USE

Now we can calculate the mass of MLSS in the Aeration Basin, as follows:

Xtss * V equals P(x,tss) * SRT

and, Xtss times V equals the value calculated and listed in cell (H252) ***19207.56*** kg

or, expressed in English terms is equal to the value in cell (H253) ***42344.99*** lbs.

Step 6. Select a <u>*Design MLSS Concentration*</u> and determine the *Aeration Tank Volume* and Detention Time.

a. We calculated the value of V * Xtss (above) as listed in cell (H252) at ***19207.56*** kg

Now let's try an MLSS value as listed in cell (H260) as 4000 mg/l

In basin, MLVSS/MLSS = 0.734919

(which would give a rough value for MLVSS in cell (H262) as 2940 mg/l

Now we can calculate the volume, as follows:

Volume equals (Xtss * V) * 1,000/MLSS conc.

The volume is calculated and listed in cell (H267), as ***4801.89*** cu. Mtrs.

or, expressed in English terms is equal to the value in cell (H268) ***169577.3*** cubic feet

or, expressed in English terms is equal to the value in cell (H269) ***1268438*** gallons

b. Determine the Aeration Tank Detention Time

Use the formula D.T. equals V/Q

Detention Time is calculated and listed in cell (H273) ***12.17775*** hours

c. Determine the actual calculated MLVSS value:

Fraction VSS equals (Xvss * V/Xtss * V), calc. & list in cell (H276) ***0.734919***

and,

MLVSS is equal to the value calculated and listed in cell (H278) ***2939.676*** mg/l

Now let's go back and re-calculate a couple of numbers using an alternative MLSS number, which we will list in cell (G281), as 4000 mg/l

Re-calculating the volume and listing in cell (G282), we get: ***4801.89*** cubic meters

or, in English terms, we get a calculated value at cell (G282) ***169577.3*** cubic feet

or in (gallons), we get ***1268438*** gallons

This gives us a net difference at (G284 - H269),gallons ***0*** gallons

Also, the Detention Time will change to: ***12.17775*** hours

Step 7. Determine F/M and BOD Volumetric Loading USING ORIGINAL VOLUME

a. Determine F/M Using M & E, Eqn. (7-60)

F/M equals Q * So/XV. This value is calc. & listed in cell (H292) ***0.217885*** g/g-day or lbs/lb-day lbs/lb-day

b. Determine the volumetric BOD Loading, using M & E Eqn. (7-61)

L(org) equals Q * So/V

This value is calculated and listed in cell (H296) ***0.640513*** kg/cu.mtr.-day

and, converting to English terms, if we multiply by 62.427, we get a BOD loading at ***39.98528*** lbs. per thousand cubic feet per day.

Step 8. Determine the observed yield based on TSS and VSS

Observed yield equals g TSS/g bCOD

P(x,tss) equals what we calculated in cell (H247), listed in cell (H305) ***2666.32*** kg/day

and, bCOD removed equals Q *(So - S)
This value is calculated and listed in cell (H307) ***3867.241*** kg/day
Y(obs,tss) equals P(x,tss)/bCOD removed, and is calculated and listed in cell (H309) ***0.689463***
kg TSS/kg bCOD or g TSS/g bCOD
or by multiplying by the value in cell (F58), we get the value in cell (H312) as Observed yield based on TSS, equals ***0.868723*** g TSS/g BOD

Now calculate the observed yield based on VSS
VSS/TSS equals value in cell (H315), (calc. in line 275) ***0.734919***
Y(obs,tss) equals Obs. Yield based on TSS * (VSS/TSS), this value is calculated and listed in cell (H317) ***0.5067*** g VSS/g bCOD

and, if we multiply by the value in cell F58, we get the following value listed in cell (H320) ***0.638441*** g VSS/g BOD

Step 9. Estimate the Effluent BOD using M & E Eqn. (8-25), p.689
BOD equals sBODe + (g BOD/1.42 g VSS) * (0.85 g VSS/g TSS) * TSS

| | | |
|---|---|---|
| Assume effluent sBODe equals in cell (G325) | 3 | mg/l |
| Assume effluent TSS equals in cell (G326) | 10 | mg/l |
| BOD equals in cell (G328) | ***8.9857*** | mg/l |
| bCOD effluent is | ***11.32198*** | mg/l |

Step 10. Secondary Clarifier Design
Check solids loading based on a recycle rate of Q, or a 1:1 recycle rate.
Solids loading equals lbs. TSS applied/S.F. of Clarifier area.
Keep under 15 lbs.per SF/day
MLSS was calculated above in cell (H260) & is ***4000*** mg/l

Area equals 2 * Q * MLSS * 8.34/15
Area is calculated and listed in cell (G337) ***11120*** SF

Step 11. Design a Pre-Anoxic Basin to go with the Nitrification Aeration Basin Calc. above.
Design for an effluent Nitrate level at (G340) 5 mg/l
Assume Nitrate concentration in RAS equals (G340) 5 mg/l
Assume mixing energy for Anoxic Reactor equals 10 kw/1000 cu. Mtrs.
Use Eqn. (7-43) and substitute V/Q for Tau
The Aerobic Detention Time was calculated and listed in cell (H272) as ***12.17775*** hours
Xb equals (Q * SRT/V) * (Y * (So - S)/1 + (k(d)) * SRT)
Where: So - S ~ So
The other data required are calculated or listed above, and are re-listed here for convenience.

| | | |
|---|---|---|
| T equals | ***21*** | degrees,C |
| Q equals | ***9463.603*** | cu. Mtrs./day |
| SRT (aerobic) equals | ***7.203773*** | days |
| V equals volume | ***4801.89*** | cu. Mtrs. |
| Y equals | ***0.459829*** | |
| k(d)(T) equals | ***0.1248*** | |
| BOD equals | ***325*** | mg/l |
| bCOD equals | ***409.5*** | mg/l |
| rbCOD equals | 133 | mg/l assumed value |
| NOx equals | ***35.10477*** | mg/l |

Tot. P equals (Estimated Value) 8 mg/l
MLSS equals *4000* mg/l
MLVSS equals *2939.676* mg/l
RAS equals 1 Q

Xb is Calculated and listed in cell (G362) *1368.819* g/cu. Mtr.

a. Determine the IR ratio using M & E, Eqn. (8-48)
Aerobic tank Nitrate Nitrogen concentration, Ne equals (G340) *5* mg/l

IR equals (NOx/Ne) - 1.0 - R
IR equals value calculated and listed in cell (H368) 5.020955
Make IR the same as winter IR 4.0

Note; This is the internal recycle ratio.

b. Determine the amount of Nitrate Nitrogen fed to the Anoxic Tank
Flowrate to the Anoxic Tank equals IR *Q* + *RQ*
Equals the value calculated and listed in cell (H374) ***47318.01*** cu. Mtrs./day

NOx feed equals value in cell (H374) * value in cell (G340)
NOx feed equals value calculated and listed in cell (H377) ***236590.1*** g/day

c. Determine the ANOXIC VOLUME
As a first approximation use an estimated detention time at (listed in cell (E382), hours 8 hours

Tau equals value in cell (E382)/24, calc. & listed in cell (H384) ***0.333333*** days

Vnox equals Tau * Q
Vnox equals value in cell (H384) * value in cell (F349), which is calculated and listed in cell (G388) ***3154.534*** cu. Mtrs.

d. Determine F/Mb using M & E Eqn. (8-43)
F/Mb equals Q * So/Vnox * Xb
F/Mb equals the value calculated and listed in cell (H392) ***0.712293*** g/g-day

e. Determine the simultaneous Denitrification Rate using the curve in M & E p. 755

Fraction of rbCOD equals rbCOD/bCOD which is calculated and listed in cell (G398) ***0.3256***
equals ***32.56003*** %

From Figure 8-23, the SDNRb equals about (cell (H401)) **0.165** g/g-day @ 20,C

Apply the temperature correction factor using M & E Eqn. (8-44)
SDNR(T) equals value in cell H401 * 1.026^(T-20)
SDNR(T) is calculated and listed in cell (H405) ***0.169238*** g/g-day

f. Determine the amount of Nitrate- Nitrogen that can be reduced using
M & E Eqn. (8-41)
Check NOr based on Tau equals value in cell (E382), hours
Tau equals value in cell (G410) ***8*** hours

NOr equals Vnox * SDNR * MLVSS, biomass
NOr equals value in cell (G388) * value in cell (H405) * value in cell (G362)
NOr equals the value calculated and listed in cell (H414) ***730769.5*** g/day

Comparing the value in cell (H414) with the value in cell (H377), we get, the following:

***236590.1*** versus ***730769.5***
Based on these numbers we have a net deficit of ***-494179*** g/day
NOTE: If the value in cell (F419) is positive, we have to go back and re-calculate.

| | |
|---|---|
| The sum of aerobic and anoxic detention times is: | ***20*** hours |

**Objective 1**

Calculate Yobs (VSS/BOD) value used in calculation of heterotrophic biomass. M&E Figure 8-7 has graphs for these figures. This worksheet uses curve fits to approximate the graphs.

| | | |
|---|---|---|
| T = | 21 | C |
| SRT = | 7.203773 | d |
| Primary? | 1 | Insert 1 if there is primary treatment |
| | | Insert 0 if there is no primary treatment |

| Primary | | No Primary | |
|---|---|---|---|
| Y = | 0.71907 | Y = | 1.045559 |
| kd = | 0.033467 | kd = | 0.023326 |
| Yobs = | 0.579385 | Yobs = | 0.895146 |

Yobs = 0.579385

Calculate Yobs (VSS/BOD) value used in calculation of heterotrophic biomass. M&E Figure 8-7 has graphs for these figures. This worksheet uses curve fits to approximate the graphs.

**Objective 2**

Calculate SDNR value used to size anoxic basin. Use Figure 8-23 to find SDNR at temperature.

F/Mb = 0.712293 g/g-day

| F/Mb Range | SDNR | |
|---|---|---|
| 0 to 2 | 0.165 | Includes 2 |
| 2 to 20 | 0.224 | |

Use if statement

SDNR = 0.165

THICKENING/DEWATERING CALCULATIONS - Phase I

**Objective 1: Determine loading to thickening belt.**

Assumptions

Belt designed for ultimate Phase II flow.
Belt designed for winter sludge flows, which are higher than summer.
Phosphorus limit remains at 0.1, necessitating heavy chemical treatment and generating alum sludge.
Assume Phase II biosolids flow is 150% of Phase I. (This has been verified)

Waste Activated Sludge

| | | | | | | |
|---|---|---|---|---|---|---|
| Q (design) = | 1.5 | mgd | | | | |
| Solids SG = | 1.6 | (4) for digested solids | | | | |
| | | Assumed for alum sludge solids | | | | |
| Mw = | 2360 | lb/d | | | | |
| TSS = | 0.008 | lb/lb | Typical is | 0.40% | to | 1.2% |
| SG = | 1.00 | | | | | |
| Mwater = | 295000 | lb/d | | | | |
| Qwater = | 35203 | gpd | | | | |

Total Sludge

| | | |
|---|---|---|
| Mw,tot = | 2360 | lb/d |
| Alum Part = | 0.0% | |
| Mwater, tot | 295000 | lb/d |
| Qwater, tot = | 35203 | gpd |
| | 24 | gpm |
| TSS = | 0.008 | lb/lb |
| SG = | 1.00 | |

To Gravity Thickening

| | | |
|---|---|---|
| Outlet TSS = | 0.04 | lb/lb |
| Capture = | 0.98 | |
| Mw = | 2313 | lb/d |
| Outlet SG = | 1.02 | |
| Mwater = | 57820 | lb/d |
| Qwater = | 6770 | gpd |
| | | |
| Mreturn = | 237180 | lb/d return |
| Qreturn = | 28439 | gpd return |

To Digestion

| | | | |
|---|---|---|---|
| HRT (d) = | 57.603985 | d | Max by Metcalf & Eddy |
| V min = | 390000 | gal | |
| | 52136 | ft3 | |
| M load | 0.035 | lb/cf d | 0.1-0.3 M&E range |

Digestion

| | | |
|---|---|---|
| Burndown = | 0.15 | Low because sludge was already subject to extended air. |
| Mw,dig = | 1966 | lb/d |
| TSS = | 0.0400 | lb/lb |
| SG = | 1.02 | |
| Mwater = | 49147 | lb/d |
| Qwater = | 5755 | gpd |
| | 4 | gpm |
| | | |
| Mdecant = | 8673 | lb/d |
| Qdecant = | 1040 | gpd |
| | 1 | gpm |

Dewatering

For aerobically digested:

| Inlet TSS | Outlet TSS | |
|---|---|---|
| 0.005 | 0.15 | |
| 0.025 | 0.19 | |
| Regression | m | b |
| Outlet | 2 | 0 |

| | | | |
|---|---|---|---|
| Belt Width = | 2 | m | |
| Flow Limits = | 150 | gpm/meter minimum | |
| | 800 | lb/h/meter maximum | (dry solids) |
| Limiting TSS = | 0.0104 | lb/lb | |
| Belt limited by | SOLIDS | loading | |
| Flow = | 39 | gpm/meter | |
| | 800 | lb/h/meter | (dry solids) |
| | 78 | gpm | |
| | 1600 | lb/h | (dry solids) |
| Dewater Time = | 1.2 | hours/day | |
| | 8.6 | hours/week | |
| | 1.7 | hours/day on 5-day week | |
| Outlet TSS = | 0.19 | lb/lb | |
| Outlet SG = | 1.11 | | |
| Capture = | 0.98 | | |
| Mw = | 2267 | lb/d | |
| Mwater = | 11929 | lb/d | |
| Qwater = | 1284 | gpd | |
| | | | |
| Mreturn = | 45891 | lb/d return | |
| Qreturn = | 5502 | gpd return | |
| Return solids = | 46 | lb/d return | (dry solids) |
| Return TSS = | 1008 | mg/l | |

Consider effect of blending return with effluent

| | | |
|---|---|---|
| Effluent TSS = | 10 | Before blending |
| | 14 | After blending |

REFERENCES
1. MOP pp 1066
2. BNR handbook, pp 117
3. AWWA
4. Metcalf

**THICKENING/DEWATERING CALCULATIONS - Phase I**

**Objective 1: Determine loading to thickening belt.**

Assumptions
Belt designed for ultimate Phase II flow.
Belt designed for winter sludge flows, which are higher than summer.
Phosphorus limit remains at 0.1, necessitating heavy chemical treatment and generating alum sludge.
Assume Phase II biosolids flow is 150% of Phase I. (This has been verified)

Waste Activated Sludge

| | | | | | | |
|---|---|---|---|---|---|---|
| Q (design) = | 2.5 | mgd | | | | |
| Solids SG = | 1.6 | (4) for digested solids | | | | |
| | | Assumed for alum sludge solids | | | | |
| Mw,VSS = | 4256 | lb/d | | | | |
| Mw = | 5803 | lb/d | | | | |
| TSS = | 0.008 | lb/lb | Typical is | 0.40% | to | 1.2% |
| SG = | 1.00 | | | | | |
| Mwater = | 725388 | lb/d | | | | |
| Qwater = | 86561 | gpd | | | | |
| Return time = | 5.4 | hours per day on a five-day week. | | | | |
| | 26.8 | hours per 5-day week | | | | |
| Actual Q = | 388175 | gpd | | | | |
| | 270 | gpm | | | | |

From Chem Precip

| | | | | | | |
|---|---|---|---|---|---|---|
| Inlet P = | 1 | ppm | Prior bio treatment | | | |
| MW of Alum = | 594 | g/mol | | | | |
| MW of P = | 31.0 | g/mol | | | | |
| Alum mass | 80.0 | g/liter | Far exceeds (1) | | | |
| P removed | 0.95 | g/liter | | | | |
| Alum mol | 0.1346001 | mol/liter | | | | |
| P mol | 0.0307 | mol/liter | | | | |
| Ratio | 4.4 | | In range of (2) | | | |
| Al mol | 0.2692 | mol/liter | | | | |
| Ratio | 8.8 | | | | | |
| Al2O3 MW = | 102 | g/mol | | | | |
| Mol Al2O3 = | 0.1346001 | mol/liter | | | | |
| Mass Al2O3 = | 13.7 | g/liter | | | | |
| | 80 | ppm 17.1% Al2O3 | | | | |
| Sludge Gen = | 0.26 | ppm/ppm 17.1% Al2O3 (3) | | | | |
| | 21 | ppm | | | | |
| Mw,al = | 435 | lb/d | | | | |
| TSS = | 0.01 | lb/lb | Typical is | 0.50% | to | 2% |
| SG = | 1.01 | | | | | |
| Mwater = | 43506 | lb/d | | | | |
| Qw,al = | 5185 | gpd | | | | |
| Return time = | 5.4 | hours per day on a five-day week. | | | | |
| | 26.8 | hours per 5-day week | | | | |
| Actual Q = | 23254 | gpd | | | | |
| | 16 | gpm | | | | |

Total Sludge

| | | |
|---|---|---|
| Mw,tot = | 6238 | lb/d |
| Alum Part = | 7.0% | |
| Mw,vss = | 4256 | lb/d |
| VSS/TSS = | 0.68 | lb/lb |
| Mwater, tot | 768894 | lb/d |
| Qwater, tot = | 91747 | gpd |
| | 64 | gpm |
| TSS = | 0.008 | lb/lb |
| SG = | 1.00 | |

To Belt Thickening

No of Belts = 1

For aerobically digested:

| Inlet TSS | Outlet TSS |
|---|---|
| 0.005 | 0.045 |
| 0.02 | 0.065 |
| m = | b = |
| 1.3 | 0.038 |

| | | |
|---|---|---|
| Belt Width = | 2 | m |
| Flow | 200 | gpm/meter |
| | 400 | gpm |
| Thicken Time = | 3.8 | hours/day |
| | 26.8 | hours/week |
| | 5.4 | hours/day on 5-day week |
| Outlet TSS = | 0.0491509 | lb/lb |
| Capture = | 0.98 | |
| Mw = | 6113 | lb/d |
| Mw,vss = | 4171 | lb/d |
| Outlet SG = | 1.03 | |
| Mwater = | 124380 | lb/d |
| Qwater = | 14486 | gpd |
| Return time = | 5.4 | hours per day on a five-day week. |
| | 26.8 | hours per 5-day week |
| Actual Q = | 64963 | gpd |
| | 45 | gpm |
| Mreturn = | 644514 | lb/d return |
| Qreturn = | 77280 | gpd return |

To Digestion

| | | |
|---|---|---|
| SRT (d) = | 28 | d Max by Metcalf & Eddy |
| Xi = | 50568 | Influent TSS (mg/l) |
| kd = | 0.06 | degradation coefficient (1/d) |
| % red VSS = | 38 | % reduction VSS |
| X | 35397 | Digester TSS |

| | | |
|---|---|---|
| Pv | 0.423 | Digester volatile fraction |
| V = | 338734 | gal |
| | 45282 | ft3 |
| M load | 0.108 | lb/cf d |

Digestion

| | | |
|---|---|---|
| Mw,dig = | 4236 | lb/d |
| TSS = | 0.0492 | lb/lb |
| SG = | 1.03 | |
| Mwater = | 86192 | lb/d |
| Qwater = | 10039 | gpd |
| | 7 | gpm |
| Return time = | 5.4 | hours per day on a five-day week. |
| | 26.8 | hours per 5-day week |
| Actual Q = | 45018 | gpd |
| | 31 | gpm |
| Mdecant = | 38188 | lb/d |
| Qdecant = | 4579 | gpd |
| | 3 | gpm |

Dewatering

For aerobically digested:

| | Inlet TSS | Outlet TSS | |
|---|---|---|---|
| | 0.005 | 0.15 | |
| | 0.025 | 0.19 | |
| Regression | | m | b |
| Outlet | | 2 | 0 |

| | | | |
|---|---|---|---|
| Belt Width = | 2 | m | |
| Flow Limits = | 150 | gpm/meter minimum | |
| | 800 | lb/h/meter maximum | (dry solids) |
| Limiting TSS = | 0.0104 | lb/lb | |
| Belt limited by | SOLIDS | loading | |
| Flow = | 32 | gpm/meter | |
| | 800 | lb/h/meter | (dry solids) |
| | 63 | gpm | |
| | 1600 | lb/h | (dry solids) |
| Dewater Time = | 2.6 | hours/day | |
| | 18.5 | hours/week | |
| | 3.7 | hours/day on 5-day week | |
| Outlet TSS = | 0.19 | lb/lb | |
| Outlet SG = | 1.11 | | |
| Capture = | 0.98 | | |
| Mw = | 5991 | lb/d | |
| Mwater = | 31532 | lb/d | |
| Qwater = | 3394 | gpd | |

| | | |
|---|---|---|
| Return time = | 3.7 | hours per day on a five-day week. |
| | 18.5 | hours per 5-day week |
| Actual Q = | 21974 | gpd |
| | 15 | gpm |

| | | |
|---|---|---|
| Mreturn = | 92848 | lb/d return |
| Qreturn = | 11133 | gpd return |
| Return solids = | 122 | lb/d return (dry solids) |
| Return TSS = | 1317 | mg/l |

<u>Returns</u>

| | | |
|---|---|---|
| Total Filtrate | 88413 | gpd |
| Decant | 4579 | gpd |

| | | |
|---|---|---|
| Total Return | 92992 | gpd |
| Return time = | 5.4 | hours per day on a five-day week. |
| | 26.8 | hours per 5-day week |
| Actual Q = | 417010 | gpd |
| | 290 | gpm |


REFERENCES

1. MOP pp 1066
2. BNR handbook, pp 117
3. AWWA
4. Metcalf

## THICKENING/DEWATERING CALCULATIONS - Phase I

### Objective 1: Determine loading to thickening belt.

Assumptions

Belt designed for ultimate Phase II flow.

Belt designed for winter sludge flows, which are higher than summer.

Phosphorus limit remains at 0.1, necessitating heavy chemical treatment and generating alum sludge.

Assume Phase II biosolids flow is 150% of Phase I. (This has been verified)

Waste Activated Sludge

| | | | | | | |
|---|---|---|---|---|---|---|
| Q (design) = | 3.75 | mgd | | | | |
| Solids SG = | 1.6 | (4) for digested solids | | | | |
| | | Assumed for alum sludge solids | | | | |
| Mw,VSS = | 6384 | lb/d | | | | |
| Mw = | 8705 | lb/d | | | | |
| TSS = | 0.008 | lb/lb | Typical is | 0.40% | to | 1.2% |
| SG = | 1.00 | | | | | |
| Mwater = | 1088082 | lb/d | | | | |
| Qwater = | 129842 | gpd | | | | |
| Return time = | 8.0 | hours per day on a five-day week. | | | | |
| | 40.1 | hours per 5-day week | | | | |
| Actual Q = | 388175 | gpd | | | | |
| | 270 | gpm | | | | |

From Chem Precip

| | | | | | | |
|---|---|---|---|---|---|---|
| Inlet P = | 1 | ppm | Prior bio treatment | | | |
| MW of Alum = | 594 | g/mol | | | | |
| MW of P = | 31.0 | g/mol | | | | |
| Alum mass | 80.0 | g/liter | Far exceeds (1) | | | |
| P removed | 0.95 | g/liter | | | | |
| Alum mol | 0.1346001 | mol/liter | | | | |
| P mol | 0.0307 | mol/liter | | | | |
| Ratio | 4.4 | | In range of (2) | | | |
| Al mol | 0.2692 | mol/liter | | | | |
| Ratio | 8.8 | | | | | |
| Al2O3 MW = | 102 | g/mol | | | | |
| Mol Al2O3 = | 0.1346001 | mol/liter | | | | |
| Mass Al2O3 = | 13.7 | g/liter | | | | |
| | 80 | ppm 17.1% Al2O3 | | | | |
| Sludge Gen = | 0.26 | ppm/ppm 17.1% Al2O3 (3) | | | | |
| | 21 | ppm | | | | |
| Mw,al = | 653 | lb/d | | | | |
| TSS = | 0.01 | lb/lb | Typical is | 0.50% | to | 2% |
| SG = | 1.01 | | | | | |
| Mwater = | 65259 | lb/d | | | | |
| Qw,al = | 7778 | gpd | | | | |
| Return time = | 8.0 | hours per day on a five-day week. | | | | |
| | 40.1 | hours per 5-day week | | | | |
| Actual Q = | 23254 | gpd | | | | |
| | 16 | gpm | | | | |

Total Sludge

| | | |
|---|---|---|
| Mw,tot = | 9357 | lb/d |
| Alum Part = | 7.0% | |
| Mw,vss = | 6384 | lb/d |
| VSS/TSS = | 0.68 | lb/lb |
| Mwater, tot | 1153341 | lb/d |
| Qwater, tot = | 137620 | gpd |
| | 96 | gpm |
| TSS = | 0.008 | lb/lb |
| SG = | 1.00 | |

To Belt Thickening

No of Belts = 1

For aerobically digested:

| Inlet TSS | Outlet TSS |
|---|---|
| 0.005 | 0.045 |
| 0.02 | 0.065 |
| m = | b = |
| 1.3 | 0.038 |

| | | |
|---|---|---|
| Belt Width = | 2 | m |
| Flow | 200 | gpm/meter |
| | 400 | gpm |
| Thicken Time = | 5.7 | hours/day |
| | 40.1 | hours/week |
| | 8.0 | hours/day on 5-day week |
| Outlet TSS = | 0.0491509 | lb/lb |
| Capture = | 0.98 | |
| Mw = | 9170 | lb/d |
| Mw,vss = | 6257 | lb/d |
| Outlet SG = | 1.03 | |
| Mwater = | 186570 | lb/d |
| Qwater = | 21730 | gpd |
| Return time = | 8.0 | hours per day on a five-day week. |
| | 40.1 | hours per 5-day week |
| Actual Q = | 64963 | gpd |
| | 45 | gpm |

| | | |
|---|---|---|
| Mreturn = | 966771 | lb/d return |
| Qreturn = | 115920 | gpd return |

To Digestion

| | | | |
|---|---|---|---|
| SRT (d) = | 30 | d | 40 CFR 253 @ 15 C |
| Xi = | 50568 | Influent TSS (mg/l) | |
| kd = | 0.06 | degradation coefficient (1/d) | |
| % red VSS = | 38 | % reduction VSS | |
| X | 35397 | Digester TSS | |

| | | |
|---|---|---|
| Pv | 0.423 | Digester volatile fraction |
| V = | 528680 | gal |
| | 70674 | ft3 |
| M load | 0.104 | lb/cf d |

Digestion

| | | |
|---|---|---|
| Mw,dig = | 6793 | lb/d |
| TSS = | 0.0491509 | lb/lb |
| SG = | 1.03 | |
| Mwater = | 138199 | lb/d |
| Qwater = | 16096 | gpd |
| | 11 | gpm |
| Return time = | 8.0 | hours per day on a five-day week. |
| | 40.1 | hours per 5-day week |
| Actual Q = | 48120 | gpd |
| | 33 | gpm |
| Mdecant = | 48371 | lb/d |
| Qdecant = | 5800 | gpd |
| | 4 | gpm |

Dewatering

For aerobically digested:

| Inlet TSS | Outlet TSS | |
|---|---|---|
| 0.005 | 0.15 | |
| 0.025 | 0.19 | |
| Regression | m | b |
| Outlet | 2 | 0 |

| | | | |
|---|---|---|---|
| Belt Width = | 2 | m | |
| Flow Limits = | 150 | gpm/meter minimum | |
| | 800 | lb/h/meter maximum | (dry solids) |
| Limiting TSS = | 0.0104 | lb/lb | |
| Belt limited by | SOLIDS | loading | |
| Flow = | 32 | gpm/meter | |
| | 800 | lb/h/meter | (dry solids) |
| | 63 | gpm | |
| | 1600 | lb/h | (dry solids) |
| Dewater Time = | 4.2 | hours/day | |
| | 29.7 | hours/week | |
| | 5.9 | hours/day on 5-day week | |
| Outlet TSS = | 0.19 | lb/lb | |
| Outlet SG = | 1.11 | | |
| Capture = | 0.98 | | |
| Mw = | 8987 | lb/d | |
| Mwater = | 47298 | lb/d | |
| Qwater = | 5091 | gpd | |

| | | |
|---|---|---|
| Return time = | 5.9 | hours per day on a five-day week. |
| | 29.7 | hours per 5-day week |
| Actual Q = | 20557 | gpd |
| | 14 | gpm |

| | | |
|---|---|---|
| Mreturn = | 139272 | lb/d return |
| Qreturn = | 16699 | gpd return |
| Return solids = | 183 | lb/d return (dry solids) |
| Return TSS = | 1317 | mg/l |

<u>Returns</u>

| | | |
|---|---|---|
| Total Filtrate | 132619 | gpd |
| Decant | 5800 | gpd |
| Total Return | 138419 | gpd |
| Return time = | 8.0 | hours per day on a five-day week. |
| | 40.1 | hours per 5-day week |
| Actual Q = | 413816 | gpd |
| | 287 | gpm |

REFERENCES
1. MOP pp 1066
2. BNR handbook, pp 117
3. AWWA
4. Metcalf

| | | |
|---|---|---|
| Total Filtrate | 132619 | 120720 |
| Decant | 5800 | 5160 |
| Total Return | 138419 | 125880 |

## Hydraulic Profile

**Screening**

Start w.s. at grade, getting grade from old thickener drawings.

| | | | |
|---|---|---|---|
| Screening w.s.: | 4096 | ft MSL | |
| Grade: | 4075 | ft MSL | |
| Top of Wall | 4098 | ft MSL | |
| Bottom of Structure | 4075 | ft MSL | Bottom of inside |
| Screen hl: | 12 | inches | |
| Baffle hl: | 24 | inches | |
| Length: | 18 | ft | Assumes 1-foot interior wall thickness |
| Width: | 13 | ft | Assumes 1-foot interior wall thickness |
| Total Structure Height: | 23 | ft | |
| Bury Depth: | 0 | ft | |
| Height above grade: | 23 | ft | |
| Freeboard: | 2 | ft | |

**Grit**

| | | | |
|---|---|---|---|
| Grit w.s.: | 4093 | ft MSL | |
| Grade: | 4075 | ft MSL | |
| Top of Wall | 4095 | ft MSL | |
| Bottom of Structure | 4065 | ft MSL | Bottom of inside |
| hl weir: | 6 | inches | |
| weir safety: | 6 | inches | |
| pipe loss: | 24 | inches | |
| Length: | 24 | ft | Assumes 1-foot wall thickness |
| Width: | 16 | ft | Assumes 1-foot wall thickness |
| Total Structure Height: | 30 | ft | |
| Bury Depth: | 10 | ft | |
| Height above grade: | 20 | ft | |
| Freeboard: | 2 | ft | |

**Selector**

| | | |
|---|---|---|
| w.s.: | 4090 | ft MSL |

| | | |
|---|---|---|
| Grade: | 4075 | ft MSL |

| | | |
|---|---|---|
| Top of Wall | 4092 | ft MSL |
| Bottom of Structure | 4068 | ft MSL |

| | | |
|---|---|---|
| splitter weir: | 6 | inches |
| weir safety: | 6 | inches |
| pipe to basin | 24 | inches |

| | | | |
|---|---|---|---|
| Length: | 52 | ft | Assumes 1-foot wall thickness |
| Width: | 28 | ft | Assumes 1-foot wall thickness |
| Total Structure Height: | 24 | ft | |
| Bury Depth: | 7 | ft | |
| Height above grade: | 17 | ft | |
| Freeboard: | 2 | ft | |

**Aeration**

| | | |
|---|---|---|
| w.s.: | 4087 | ft MSL |
| Grade: | 4076 | ft MSL |

| | | |
|---|---|---|
| Top of Wall | 4089 | ft MSL |
| Bottom of Structure | 4063 | ft MSL |

| | | |
|---|---|---|
| weir | 6 | inches |
| weir safety | 6 | inches |
| pipe to clarifier | 24 | inches |

| | | |
|---|---|---|
| Total Structure Height: | 26 | ft |
| Bury Depth: | 13 | ft |
| Height above grade: | 13 | ft |
| Freeboard: | 2 | ft |

See individual alternative worksheets for lateral dimensions of the aeration basins. These differ by alternative.

**Clarifiers** (Note, Alt 3 uses no clarifiers, so for this, neglect the clarifier headloss.)

| | | | |
|---|---|---|---|
| w.s.: | 4084 | ft MSL | |
| Grade: | 4070 | ft MSL | Will require some grading |

| | | |
|---|---|---|
| Top of Wall | 4086 | ft MSL |
| Bottom of Structure | 4070 | ft MSL |

| | | | |
|---|---|---|---|
| hl weir | 6 | inches | |
| weir safety | 6 | inches | |
| pipe to UV | 24 | inches | |
| Diameter: | 80 | ft | inner |
| Total Structure Height: | 16 | ft | |
| Bury Depth: | 0 | ft | Room for a 2-foot slab. |
| Height above grade: | 16 | ft | |
| Freeboard: | 2 | ft | |

**UV**

| | | | |
|---|---|---|---|
| avail equiv w.s: | 4081 | ft MSL | (For Alt 3, 4084 ft MSL) |
| Finished floor | 4062 | ft MSL | |
| Max equiv w.s.: | 4066.7 | ft MSL | |

NOTE, THIS REQUIRES NEW FLUME OR MAG METER.

**Remaining for P treatment**

Remaining w.s. 14.3 ft head available for chemical P removal.

(For Alt 3, remaining is 17.3 ft head available for chemical P removal.)

## CONCRETE DEMOLITION AND BACKFILL

The following demolition items are common to all alternatives. The demolition is to be done in stages, as described in the staging drawings for Alternative 1.

Stage 1

This stage re-routes waste activated sludge to a new belt thickener, then returns thickened sludge to the existing digester. Digested sludge is then routed to a belt press in the same building as the belt thickener. This process modification allows the existing gravity thickener to be taken offline and demolished.

Concrete to be demolished:

| | | |
|---|---|---|
| Wall 1 - upper wall - mostly above grade | | |
| ID = | 43.333 | ft |
| OD = | 45.333 | ft |
| h = | 4 | ft |
| V = | 557 | cf |
| | 21 | cy |
| Wall 2 - lower wall below grade | | |
| ID = | 40 | ft |
| OD = | 42 | ft |
| h = | 8.5 | ft |
| V = | 1095 | cf |
| | 41 | cy |
| Slab 1 - About 3 feet below grade | | |
| ID = | 42 | ft |
| OD = | 45.333 | ft |
| h = | 1 | ft |
| V = | 229 | cf |
| | 8 | cy |
| Slab 2 - About 10 feet deep | | |
| ID = | 38.5 | ft |
| OD = | 43.5 | ft |
| h = | 1 | ft |
| V = | 322 | cf |
| | 12 | cy |
| Slab 3 - About 10 feet deep | | |
| ID = | 0 | ft |
| OD = | 38.5 | ft |
| h = | 1 | ft |
| V = | 1164 | cf |
| | 43 | cy |

| Totals | | |
|---|---|---|
| Wall Concrete = | 61 | CY |
| Slab Concrete = | 64 | CY |
| Backfill = | 652 | CY |

Backfill

| | | |
|---|---|---|
| Upper Section | | |
| ID = | 0 | ft |
| OD = | 47.33334 | ft |
| h = | 10 | ft |
| V = | 17596 | cf |
| | 652 | cy |

Stage 2

Install new influent pump station, RAS pump station, headworks, anaerobic selector, and splitter. Demolish existing influent and RAS pump stations, headworks, and splitter.

*Lower and Upper Pump Station* (Assume they are about the same)

Level Slab 1 - Parshall Flume Area, about 13 feet below grade.

| | | |
|---|---|---|
| Depth = | 13 | ft |
| L = | 14.91 | ft |
| W = | 8 | ft |
| t = | 1 | ft |
| V(conc) = | 119 | cf |
| | 4 | cy |
| V (fill) = | 1551 | cf |
| | 57 | cy |

Level Slab 2 - Base of Pumps, about 13 feet below grade.

| | | |
|---|---|---|
| Depth = | 13.5 | ft |
| L = | 15.6667 | ft |
| W = | 10.1 | ft |
| t = | 1.5 | ft |
| V(conc) = | 237 | cf |
| | 9 | cy |
| V (fill) = | 2136 | cf |
| | 79 | cy |

Level Slab 3 - top of pumps and open area, about 5 feet below grade.

| | | |
|---|---|---|
| Depth = | 5 | ft |
| L = | 20 | ft |
| W = | 20 | ft |
| t = | 1 | ft |
| V(conc) = | 400 | cf |
| | 15 | cy |
| V (fill) = | 2000 | cf |
| | 74 | cy |

Sloped Slab 1 - Area below pumps, sloped at 38 degrees.

| | | | |
|---|---|---|---|
| Depth = | 13 | ft | (to 5) |
| L = | 39.333 | ft | |
| W = | 20 | ft | |
| t = | 0.5 | ft | |
| V(conc) = | 393 | cf | |
| | 15 | cy | |
| V (fill) = | 5113 | cf | |
| | 189 | cy | |

Lower Walls, from grade to 12 feet deep.

| | | |
|---|---|---|
| h = | 11.69 | ft |
| t = | 1 | ft |
| L = | 140.134 | ft |
| V(conc) = | 1638 | cf |
| | 61 | cy |

Sloped Walls, from grade to 12 feet deep

| | | |
|---|---|---|
| h = | 11.69 | ft |
| t = | 0.666667 | ft |
| L = | 82.36 | ft |
| V(conc) = | 321 | cf |
| | 12 | cy |

Upper Walls, partially below grade

| | | |
|---|---|---|
| h = | 5 | ft |
| t = | 0.666667 | ft |
| L = | 34.82 | ft |
| V(conc) = | 116 | cf |
| | 4 | cy |

Lower Lift Totals

| | | |
|---|---|---|
| Slab = | 43 | CY |
| Wall = | 77 | CY |
| Fill = | 400 | CY |

Upper Lift Totals

| | | |
|---|---|---|
| Slab = | 43 | CY |
| Wall = | 77 | CY |
| Fill = | 200 | CY |

*Headworks*

Slab on Grade - Grit Classifier

| | | |
|---|---|---|
| L = | 16 | ft |
| W = | 8 | ft |
| t = | 0.5 | ft |
| V(conc) = | 64 | cf |
| | 2 | cy |

Grit Base Slab - Excluding Hopper

| | | |
|---|---|---|
| Depth = | 12.5 | ft |
| L = | 28 | ft |
| W = | 18 | ft |
| t = | 1.5 | ft |
| V(conc) = | 525 | cf |
| | 19 | cy |
| V (fill) = | 6300 | cf |
| | 233 | cy |

Grit Hopper - 12.5 to 18.5 feet deep

| | | |
|---|---|---|
| Depth = | 8 | ft |
| L = | 14 | ft |
| W = | 14 | ft |
| t = | 1.5 | ft |
| V(conc) = | 712 | cf |
| | 26 | cy |
| V (fill) = | 784 | cf |
| | 29 | cy |

Grit Basin Grout, considered same as base concrete.

| | | |
|---|---|---|
| Base = | 10 | ft |
| Height = | 10 | ft |
| L = | 14 | ft |
| V (grout) = | 700 | cf |
| | 26 | cy |

Screening and Channels Base Slab, 3 to 5 feet deep.

| | | |
|---|---|---|
| Depth = | 8 | ft |
| L = | 214 | ft |
| W = | 5 | ft |
| t = | 1 | ft |
| V(conc) = | 1070 | cf |
| | 40 | cy |
| V (fill) = | 8560 | cf |
| | 317 | cy |

Scum & Grease Digester Slab, 15 feet deep.

| | | |
|---|---|---|
| Depth = | 15 | ft |
| L = | 14 | ft |
| W = | 14 | ft |
| t = | 1.5 | ft |
| V(conc) = | 294 | cf |
| | 11 | cy |
| V (fill) = | 2940 | cf |
| | 109 | cy |

Screening and Channel Walls

| | | |
|---|---|---|
| L = | 372 | ft |
| h = | 4 | ft |
| t = | 0.666667 | ft |
| V(conc) = | 992 | cf |
| | 37 | cy |

Grit Walls

| | | |
|---|---|---|
| h = | 14.5 | ft |
| t = | 1 | ft |
| L = | 88 | ft |
| V(conc) = | 1276 | cf |
| | 47 | cy |

Grease Digester Walls

| | | |
|---|---|---|
| h = | 14 | ft |
| t = | 1.5 | ft |
| L = | 56 | ft |
| V(conc) = | 1176 | cf |
| | 44 | cy |

Total Headworks

| | |
|---|---|
| Slab = | 125 CY |
| Wall = | 128 CY |
| Fill = | 688 CY |

*Splitter*

Slab

| | | |
|---|---|---|
| Depth = | 5 | ft |
| Slab Area | 778 | sf |
| t = | 1 | |
| V(conc) = | 778 | cf |
| | 29 | cy |
| V (fill) = | 3890 | cf |
| | 144 | cy |

Walls

| | | |
|---|---|---|
| h = | 7 | ft |
| t = | 0.666667 | ft |
| L = | 185 | ft |
| V(conc) = | 863 | cf |
| | 32 | cy |

Total Splitter

| | | |
|---|---|---|
| Slab = | 29 | CY |
| Wall = | 32 | CY |
| Fill = | 144 | CY |

Aeration/Digestion/Equalization Module

Slab

| | | |
|---|---|---|
| Depth = | 14.22 | ft |
| Slab Area | 20445 | sf |
| t = | 1 | |
| V(conc) = | 20445 | cf |
| | 757 | cy |
| V (fill) = | 290727.9 | cf |
| | 10768 | cy |

Walls

| | | | |
|---|---|---|---|
| h = | 14 | ft | |
| A = | 18947.5 | ft | |
| V module | 265265 | cf | |
| V subtract | 187152 | cf | Basin capacities |
| Vsubtract | 31192 | cf | Account for freeboard |
| Vremain | 46921 | cf | |
| | 1738 | cy | |

Total Module

| | | |
|---|---|---|
| Slab = | 757 | CY |
| Wall = | 1738 | CY |
| Fill = | 10768 | CY |

Total Demolition

| | | |
|---|---|---|
| Slab = | 1059 | CY |
| Wall = | 2112 | CY |
| Fill = | 12852 | CY |

Flows

| Phase | Q design (MGD) | Peak Factor | Q 2h peak (MGD) |
|---|---|---|---|
| O | 1.4 | 2.6 | 3.64 |
| I | 2.5 | 2.6 | 6.5 |
| II | 3.75 | 2.6 | 9.75 |

Pipe Selection - Total Flow

Pipe D = 18.62 in DIP

| Phase | v design (fps) | v peak (fps) |
|---|---|---|
| O | 1.15 | 2.98 |
| I | 2.05 | 5.32 |
| II | 3.07 | 7.98 |

Influent Pump Station

Flow/Pump = 9.75 MGD
6771 gpm

| Pumps Online | Flow (MGD) | Flow (gpm) | |
|---|---|---|---|
| 0.77 | 7.50 | 5208 | VFD |
| 1 | 9.75 | 6771 | |
| 2 | 19.50 | 13542 | Phase I peak |
| 3 | 29.25 | 20313 | Phase II peak |

| Cost | No. Pumps | Q | TDH (ft) |
|---|---|---|---|
| Phase I | 3 | 6771 | 65 |
| Phase II | 1 | 6771 | 65 |

RAS Pump Station

Design for 1 Q
Must pump up to 1.5 Q

Flows:

| Phase | Q design (MGD) | Q max (MGD) |
|---|---|---|
| O | 1.4 | 2.10 |
| I | 2.5 | 3.75 |
| II | 3.75 | 5.63 |

Flow/Pump = 1.88 MGD
1302 gpm

| Pumps Online | Flow (MGD) | Flow (gpm) | |
|---|---|---|---|
| 0.80 | 1.50 | 1042 | VFD |
| 1 | 1.88 | 1302 | |
| 2 | 3.75 | 2604 | Phase I |
| 3 | 5.63 | 3906 | Phase II |

| Cost | No. Pumps | Q | TDH (ft) |
|---|---|---|---|
| Phase I | 3 | 1302 | 30 |
| Phase II | 1 | 1302 | 30 |

WAS Pumps

Flows:

| Phase | Q design (gpd) |
|---|---|
| I | 78500 |
| II | 117500 |

Flow/Pump = $\boxed{39250}$ gpd
27 gpm

| Pumps Online | Flow (MGD) | Flow (gpm) | |
|---|---|---|---|
| 1 | 39250 | 27 | |
| 2 | 78500 | 55 | Phase I |
| 3 | 117750 | 82 | Phase II |

| Cost | No. Pumps | Q | TDH (ft) |
|---|---|---|---|
| Phase I | 3 | 27 | 40 |
| Phase II | 1 | 27 | 40 |

Thickened/Digested

Flow = 20000 gpd
14 gpm

| Cost | No. Pumps | Q | % Solids |
|---|---|---|---|
| Phase I | 2 | 15 | 6 |

Returns

| Phase | Flow (gpm) | Head (ft) |
|---|---|---|
| I & II | 290 | 55 |

**CLARIFIER SIZING**

Load

| | | | |
|---|---|---|---|
| Flow = | 1.25 | mgd | design |
| | 3.25 | mgd | 2-hour peak |
| Flow = | 868 | gpm | design |
| | 2257 | gpm | 2-hour peak |
| MLSS = | 5000 | mg/l | Conservative assumption |
| Solids Loading = | 52159 | lb/d | design |
| | 135613 | lb/d | peak |

Standards

| | | | |
|---|---|---|---|
| Design Volumetric = | 400 | gpd/sf | |
| 2-Hour Peak Volume | 700 | gpd/sf | |
| Floor Loading = | 15 | lb/d/sf | at design flow |
| Floor Loading = | 33 | lb/d/sf | at peak flow |
| HRT less than | 8 | hours | at design flow |

Required Areas

| | | | |
|---|---|---|---|
| A = | 3125 | sf | For design volumetric flow |
| A = | 4643 | sf | For design 2-hour peak flow |
| A = | 3477 | sf | Floor loading at design flow |
| A = | 4109 | sf | Floor loading at peak flow |

Required Diameter

D = 79 sf

Volume and HRT

Chosen Diameter is

| | | | |
|---|---|---|---|
| Diameter = | 80 | ft | |
| Depth = | 16 | ft | per NMED |
| Area = | 4778 | sf | |
| Volume = | 76454 | cf | |
| | 10220 | gal | |
| HRT = | 12 | min | |

## Size Rapid Mix and Flocculation Basins

Returns Flow = 290 gpm, which is max possible given the times set aside for sludge dewatering.

| | | |
|---|---|---|
| Rapid Mix HRT = | 5 | min |
| Floc HRT = | 20 | min |
| Basin SWD = | 6 | ft |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Rapid Mix = | 1448 | gal | = | 194 | cf | = | 32 | sf |
| Flocculation = | 5792 | gal | = | 774 | cf | = | 129 | sf |
| Total = | 7240 | gal | = | 968 | cf | = | 161 | sf |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Refreshment Sta. SWD | 15 | ft | | | | | | |
| Refreshment Station = | 14700 | gal | = | 1965 | cf | = | 131 | sf |

For rapid mix and flocculation, use a single basin.
Use separate basin for refreshment.

Rapid Mix, Floc

| | | |
|---|---|---|
| Width = | 8 | ft |
| Internal Wall = | 0.5 | ft thick |
| Outer walls = | 1 | ft thick |

| | | |
|---|---|---|
| Rapid Mix Length = | 4 | ft |
| Flocculation Length = | 16 | ft |
| Overall Basin outer W | 10 | ft |
| Overall Basin outer L = | 23 | ft |

# APPENDIX D

# ALTERNATIVE 1
# CONVENTIONAL BIOLOGICAL NUTRIENT REMOVAL (BNR)

# CONCEPTUAL PROJECT COSTS

# ALTERNATIVE 1 - CONVENTIONAL BIOLOGICAL NUTRIENT REACTOR
# CONCEPTUAL PROJECT COSTS
# WASTEWATER TREATMENT PLANT IMPROVEMENTS

| Construction Costs | Amount |
|---|---|
| Anaerobic Selector with Alkalinity Augmentation | $559,000 |
| Aeration Basin and Blowers/Canopy Structure | $4,586,000 |
| Influent Pump Station | $1,332,000 |
| Secondary Clarifiers | $1,520,000 |
| Mechanical Dewatering Facilities | $1,776,000 |
| Aerobic Digester and Blower Structure | $1,227,000 |
| Chemical Precipitation Filtrate - Phosphorus Removal | $775,000 |
| Phosphorus Filtrate Pump Station | $234,000 |
| UV Disinfection Building | $656,000 |
| Yard Piping Improvements | $439,000 |
| Site Improvements | $176,000 |
| Headworks | $706,000 |
| RAS/WAS Pump Station | $594,000 |
| Laboratory and Administration/Control Building | $1,355,000 |
| Electrical | $1,753,000 |
| Laboratory Testing Services | $100,000 |
| Subtotal | $17,788,000 |
| | |
| Other Support Facilities: | |
| Building in lieu of Blower Canopy | $620,000 |
| Demolition | $1,441,000 |
| Subtotal | $2,061,000 |
| | |
| Subtotal of New Facilities | $19,849,000 |
| Construction Contingencies @ 10% | $1,985,000 |
| Subtotal | $21,834,000 |
| | |
| NMGRT @ 7.6875% | $1,678,000 |
| Total Construction Costs | $23,512,000 |
| | |
| **Professional Engineering Services Allowance @ 9.5%** | |
| Basic design services and allowance for special services including construction inspection (18 months), soils investigation, surveys, aerial mapping, operation and maintanance manual, and startup services | $2,234,000 |
| | |
| NMGRT @ 6.75% | $151,000 |
| Total Professional Engineering Services | $2,385,000 |
| | |
| **Total Project Costs** | $25,897,000 |

**CONSTRUCTION COST ESTIMATE - ALTERNATIVE 1 CONVENTIONAL BNR**

COST SUMMARY
MOLZEN-CORBIN & ASSOCIATES
JOB NO: RUI 21-71.D03

PREPARED BY: A. Campos
PRINT DATE:
DATE PREPARED: 1/10/2005

| ITEM | DESIGN COST ESTIMATE |
|---|---|
| Item D: Anaerobic Selector with Alkalinity Augmentation | $559,200 |
| Item E: Aeration Basin and Blowers/ Canopy Structure | $4,585,800 |
| Item F: Influent Pump Station | $1,331,700 |
| Item G: Secondary Clarifiers | $1,519,800 |
| Item J: Mechanical Dewatering Building | $1,775,900 |
| Item K: Aerobic Digester and Blower Structure | $1,227,300 |
| Item L: Chemical Precipitation Filtration - Phosphorus Removal | $774,900 |
| Item M: Phosphorus Filtrate Pump Station | $234,000 |
| Item N: UV Disinfection and Building | $656,200 |
| Item Q: Yard Piping Improvements | $438,800 |
| Item R: Site Improvements | $175,500 |
| Item S: Headworks | $706,000 |
| Item T: RAS & WAS Pump Station | $594,100 |
| Item V: Laboratory and Administration/Control Building | $1,354,900 |
| Electrical | $1,752,800 |
| Item U: Laboratory Testing Services | $100,000 |
| Item W: Demolition | $1,441,200 |
| Item X: Building Inlieu of Canopy | $620,100 |
| SUBTOTAL | $19,848,200 |
| Construction Contingencies 10.00% | $1,984,820 |
| TOTAL | $21,833,020 |
| STATE TAX (construction) 7.6875% | $1,678,413 |
| TOTAL ESTIMATED CONSTRUCTION COSTS | $23,511,433 |

PRELIMINARY COST ESTIMATE — Alternative 1 Conventional Biological Nutrient Removal

Item D: Anaerobic Selector with Alkalinity Augmentation — DATE: Dec 20, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **28x52x24 (22'SWD)** | | | | |
| Concrete Walls | cy | 280 | $500.00 | $140,000 |
| Concrete Floor | cy | 100 | $500.00 | $50,000 |
| Excavation | cy | 900 | $10.00 | $9,000 |
| Backfill and compaction | cy | 400 | $12.00 | $4,800 |
| Interior Painting | ls | 7100 | $4.00 | $28,400 |
| Exterior Painting | ls | 3100 | $4.00 | $12,400 |
| Stairways and platform | ea | 3 | $12,000.00 | $36,000 |
| Miscellaneous metal works | ls | 1 | $6,000.00 | $6,000 |
| **Equipment** | | | | |
| Mechanical Mixer: Equipment | ea | 4 | $20,250.00 | $81,000 |
| Mechanical Mixer: Installation | ls | 0.35 | $81,000.00 | $28,350 |
| Support bridges for mixers w/ grating & handrail | ea | 4 | $7,500.00 | $30,000 |
| Support bridges for mixers: installation | ls | 0.35 | $30,000.00 | $10,500 |
| Structure Piping: 30" | lf | 30 | $100.00 | $3,000 |
| Structure Piping: 18" RAS | lf | 15 | $60.00 | $900 |
| 30" Bypass piping | lf | 70 | $100.00 | $7,000 |
| Slide gates with installation | ea | 3 | $7,000.00 | $21,000 |
| **Alkalinity Augmentation** | | | | |
| Place metering pumps, piping and chemical storage in Headworks Structure | | | | |
| Liquid soda ash feed pumps: equipment | ea | 2 | $2,000.00 | $4,000 |
| Liquid soda ash feed pumps: installation | ls | 0.5 | $4,000.00 | $2,000 |
| Piping | lf | 40 | $10.00 | $400 |
| Misc valves and support | ls | 1 | $200.00 | $200 |
| Soda Ash Containment Area Liner | ls | 1 | $3,000.00 | $3,000 |
| SUBTOTAL | | | | $477,950.00 |
| Undefined Elements 10.00% | | | | $47,795 |
| General Conditions 4.00% | | | | $19,118 |
| Mobilization & Shakedown 3.00% | | | | $14,339 |
| TOTAL | | | | $559,200.00 |

PRELIMINARY COST ESTIMATE — Alternative 1 Conventional Biological Nutrient Removal
Item E: Aeration Basin and Blowers/ Canopy Structure — DATE: Dec 22, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **Aeration Basin Structure: 146 x 140 x 24 (22 SWD)** | | | | |
| Concrete walls | cy | 1220 | $500.00 | $610,000 |
| Concrete floor | cy | 1240 | $500.00 | $620,000 |
| Concrete walkway | cy | 11 | $500.00 | $5,500 |
| Inlet and outlet boxes | cy | 60 | $500.00 | $30,000 |
| Excavation | cy | 16100 | $10.00 | $161,000 |
| Backfill | cy | 3900 | $12.00 | $46,800 |
| Miscellaneous metal works | ls | 1 | $30,000.00 | $30,000 |
| Painting Interior | sf | 28000 | $4.00 | $112,000 |
| Painting Exterior | sf | 8300 | $4.00 | $33,200 |
| Stairways | ea | 2 | $12,000.00 | $24,000 |
| Hand Rail | lf | 600 | $18.00 | $10,800 |
| | | | | |
| **Piping** | | | | |
| Air Piping Header (16") HDG | lf | 160 | $70.00 | $11,200 |
| Air Piping Header (14") HDG | lf | 110 | $60.00 | $6,600 |
| Air Piping Header (10") HDG | lf | 110 | $50.00 | $5,500 |
| Misc air piping supports, etc | ls | 1 | $8,000.00 | $8,000 |
| Drain Piping and valves | lf | 200 | $60.00 | $12,000 |
| Basin internal recycle pipes: 30" DIP | lf | 260 | $100.00 | $26,000 |
| | | | | |
| **Aeration Basin Equipment** | | | | |
| Air bridges, shear tubes, valves, etc: equipment | ls | 1 | $500,000 | $500,000 |
| Air bridges, shear tubes, etc: installation | ls | 0.45 | $500,000 | $225,000 |
| 16" air lift pumps and controls (6 total) | ls | 1.45 | $58,000 | $84,100 |
| 48" W Down opening weir gates: equipment | ea | 2 | $6,400 | $12,800 |
| 48" W Down opening weir gates: installation | ls | 0.45 | $12,800 | $5,760 |
| 36" W Down opening weir gates: equipment | ls | 3 | $3,600 | $10,800 |
| 36" W Down opening weir gates: installation | ls | 0.45 | $10,800 | $4,860 |
| Scum removal telescoping pan | ls | 1.45 | $3,000 | $4,350 |
| | | | | |
| **Pre Anoxic Basins** | | | | |
| Concrete walls | cy | Included w/ aeration basins | | n/a |
| Concrete floor | cy | Included w/ aeration basins | | n/a |
| Painting | ls | Included w/ aeration basins | | n/a |
| | | | | |
| Equipment | | | | |
| Mechanical Mixer: Equipment | ea | 8 | $13,750.00 | $110,000 |
| Mechanical Mixer: Installation | ls | 0.35 | $110,000.00 | $38,500 |
| Support bridges for mixers w/ grating & handrail | ea | 8 | $8,500.00 | $68,000 |
| Support bridges for mixers: installation | ls | 0.35 | $68,000.00 | $23,800 |
| | | | | |
| **Blower Structure** | | | | |
| Blower and accessories: equipment (4 blower) | ls | 1 | $267,500 | $267,500 |
| Blower and accessories: installation | ls | 0.35 | $93,625 | $93,625 |
| Air Piping Header (24") HDG | lf | 40 | $120.00 | $4,800 |
| Blower piping and valves | ls | 1 | $55,000.00 | $55,000 |
| | | | | |
| Canopy Cover Structure 60x60 | sf | 3600 | $30.00 | $108,000 |
| Site preparation | ls | 1 | $10,000.00 | $10,000 |
| | | | | |
| Emergency Generator | ls | 1.35 | $400,000.00 | $540,000 |
| SUBTOTAL | | | | $3,919,495.00 |
| Undefined Elements 10.00% | | | | $391,950 |
| General Conditions 4.00% | | | | $156,780 |
| Mobilization & Shakedown 3.00% | | | | $117,585 |
| TOTAL | | | | $4,585,800.00 |

PRELIMINARY COST ESTIMATE
Item F: Influent Pump Station

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 29, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| **Lift Station Structure** | | | | | |
| Wet well structure | 20L x 12W x 20D | cy | 1208 | $500.00 | $604,000 |
| Excavation | | cy | 1720 | $10.00 | $17,200 |
| Backfill | | cy | 1440 | $12.00 | $17,280 |
| Metal Work (includes hoist structure) | | ls | 1 | $20,000.00 | $20,000 |
| Valve Pit Structure | | ls | 1 | $30,000.00 | $30,000 |
| Dewatering | | ls | 1 | $25,000.00 | $25,000 |
| **Equipment** | | | | | |
| 3 submersible pumps and accessories | | ls | 1.55 | $118,820.00 | $184,171 |
| Installation of well well piping | | ls | 1 | $40,000.00 | $40,000 |
| Wet well fan and accessories | | ls | 1 | $10,000.00 | $10,000 |
| Piping in wetwell and valve pit | | ls | 1 | $26,000.00 | $26,000 |
| Inlet Sewer | | ls | 1 | $12,000.00 | $12,000 |
| Crane | | ls | 1 | $26,000.00 | $26,000 |
| Forcemain header | | ls | 1 | $24,000.00 | $24,000 |
| Painting Interior | | sf | 1350 | $8.00 | $10,800 |
| Painting Exterior | | sf | 480 | $4.00 | $1,920 |
| Painting Top Deck | | sf | 240 | $4.00 | $960 |
| 18" Flow Meter | | ls | 1.9 | $4,655.00 | $8,845 |
| Building for Electrical Equipment | | sf | 400 | $200.00 | $80,000 |
| SUBTOTAL | | | | | $1,138,175.50 |
| Undefined Elements | 10.00% | | | | $113,818 |
| General Conditions | 4.00% | | | | $45,527 |
| Mobilization & Shakedown | 3.00% | | | | $34,145 |
| TOTAL | | | | | $1,331,700.00 |

PRELIMINARY COST ESTIMATE
Item G: Secondary Clarifiers

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 20, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **80' Clarifier Structure (each)** | | | | |
| Concrete Walls | cy | 252 | $500.00 | $126,000 |
| Concrete Floor | cy | 280 | $500.00 | $140,000 |
| Concrete Walkway | cy | 8 | $500.00 | $4,000 |
| Stairs | ls | 1 | $2,000.00 | $2,000 |
| Walkway Handrailing | lf | 18 | $500.00 | $9,000 |
| Excavation | cy | 7200 | $10.00 | $72,000 |
| Backfill and compaction | cy | 2300 | $12.00 | $27,600 |
| Interior Painting | ls | 1200 | $6.00 | $7,200 |
| Exterior Painting | ls | 1200 | $4.00 | $4,800 |
| Miscellaneous piping | ls | 1 | $12,000.00 | $12,000 |
| Clarifier Equipment and Accessories: equipment | ls | 1 | $158,000.00 | $158,000 |
| Clarifier Equipment and Accessories: installation | ls | 0.55 | $158,000.00 | $86,900 |
| 2nd Clarifier | ls | 1 | $649,500.00 | $649,500 |
| SUBTOTAL | | | | $1,299,000.00 |
| Undefined Elements 10.00% | | | | $129,900 |
| General Conditions 4.00% | | | | $51,960 |
| Mobilization & Shakedown 3.00% | | | | $38,970 |
| TOTAL | | | | $1,519,800.00 |

PRELIMINARY COST ESTIMATE
Item J: Mechanical Dewatering Building

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 15, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| Dewatering Structure | | | | |
| Building 60 85 | sf | 5100 | $150.00 | $765,000 |
| Thickening Belt, SS Frame | ls | 1 | $118,000.00 | $118,000 |
| Thickening Belt: installation | ls | 0.2 | $23,600.00 | $23,600 |
| Control Panel | ls | 1 | $30,000.00 | $30,000 |
| Alum platform and stairs | ls | 1 | $25,000.00 | $25,000 |
| Alum platform and stairs: installation | ls | 0.35 | $8,750.00 | $8,750 |
| Thickened sludge hopper | ls | 1 | $5,000.00 | $5,000 |
| Thickened sludge hopper: installation | ls | 0.35 | $1,750.00 | $1,750 |
| Polymer system: equipment | ls | 1 | $16,000.00 | $16,000 |
| Polymer system: installation | ls | 0.45 | $7,200.00 | $7,200 |
| Dewatering Belt, SS Frame | ls | 1 | $262,500.00 | $262,500 |
| Thickening Belt: installation | ls | 0.2 | $52,500.00 | $52,500 |
| Control Panel | ls | 1 | $40,000.00 | $40,000 |
| Alum platform and stairs | ls | 1 | $25,000.00 | $25,000 |
| Alum platform and stairs: installation | ls | 0.35 | $8,750.00 | $8,750 |
| Conveyor system | ls | 1 | $37,000.00 | $37,000 |
| Conveyor system: installation | ls | 0.45 | $16,650.00 | $16,650 |
| Polymer system: equipment | ls | 1 | $16,000.00 | $16,000 |
| Polymer system: installation | ls | 0.45 | $7,200.00 | $7,200 |
| Thickened Sludge Pumps (Voglesand) | ea | 2 | $10,000.00 | $20,000 |
| Thickened Sludge Pumps: installation | ls | 0.35 | $20,000.00 | $7,000 |
| Flow meter | ls | 1 | $8,000.00 | $8,000 |
| Piping, fittings, valves | ls | 1 | $7,000.00 | $7,000 |
| Miscellaneous Metal Works | ls | 1 | $4,000.00 | $4,000 |
| Washwater piping system | ls | 1 | $6,000.00 | $6,000 |
| SUBTOTAL | | | | $1,517,900.00 |
| Undefined Elements 10.00% | | | | $151,790 |
| General Conditions 4.00% | | | | $60,716 |
| Mobilization & Shakedown 3.00% | | | | $45,537 |
| TOTAL | | | | $1,775,900.00 |

PRELIMINARY COST ESTIMATE
Item K: Aerobic Digester and Blower Structure

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 21, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **Size: 28x28x22 swd (three basins total)** | | | | |
| Equipment for Basin | | | | |
| Process aeration equipment | ls | 1.45 | $135,000.00 | $195,750 |
| 8" telescoping valves (3 total) | ls | 1.45 | $28,000.00 | $40,600 |
| Platforms and stairs | ls | 1 | $20,000.00 | $20,000 |
| Down opening weir gates | ea | 4 | $4,000.00 | $16,000 |
| Handrail | lf | 120 | $18.00 | $2,160 |
| Basin Structure | | | | |
| Concrete Walls | cy | 385 | $500.00 | $192,500 |
| Concrete Floor | cy | 165 | $500.00 | $82,500 |
| Concrete walkway | cy | 5 | $500.00 | $2,500 |
| Excavation and Backfill | ls | 1 | $4,000.00 | $4,000 |
| Interior coating system | sf | 8070 | $4.00 | $32,280 |
| Exterior coating system | sf | 4720 | $4.00 | $18,880 |
| 10" air piping and valves 3 each | lf | 80 | $50.00 | $4,000 |
| 8" supernatant drain line | lf | 30 | $40.00 | $1,200 |
| 8" supernatant drain shutoff valves | ea | 3 | $400.00 | $1,200 |
| Blower and Digested Pump Structure | | | | |
| Building 40 30 | sf | 1200 | $150.00 | $180,000 |
| PD blowers: equipment 4 total | ls | 1 | $131,500.00 | $131,500 |
| PD blowers: installation | ls | 0.45 | $59,175.00 | $59,175 |
| Blower piping and valves (8" discharge to 16" header | ls | 1 | $15,000.00 | $15,000 |
| Blower shut off valves | ea | 4 | $400.00 | $1,600 |
| Blower check valves | ea | 4 | $300.00 | $1,200 |
| Digested Sludge Pumps (Voglesand) | ea | 2 | $11,000.00 | $22,000 |
| Digested Sludge Pumps: installation | ls | 0.45 | $22,000.00 | $9,900 |
| Flow meter | ls | 1 | $8,000.00 | $8,000 |
| Piping, fittings, valves | ls | 1 | $7,000.00 | $7,000 |
| SUBTOTAL | | | | $1,048,945.00 |
| Undefined Elements 10.00% | | | | $104,895 |
| General Conditions 4.00% | | | | $41,958 |
| Mobilization & Shakedown 3.00% | | | | $31,468 |
| TOTAL | | | | $1,227,300.00 |

PRELIMINARY COST ESTIMATE — Alternative 1 Conventional Biological Nutrient Removal

Item L: Chemical Precipitation Filtration - Phosphorus Removal — DATE: Dec 20, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **Equipment Removal** | | | | |
| Remove clarifier equipment and center column | crew-day | 10 | $2,000.00 | $20,000 |
| Remove clarifier equipment and center column | crew-day | 10 | $2,000.00 | $20,000 |
| | | | | $0 |
| Structure Improvements | ea | 2 | $25,000.00 | $50,000 |
| Interior painting | ea | 3000 | $7.00 | $21,000 |
| Exterior painting | ea | 1400 | $6.00 | $8,400 |
| Miscellaneous piping | ea | 2 | $9,000.00 | $18,000 |
| **Equipment: 55' diameter** | | | | |
| New Clarifier Mechanism: equipment | ea | 2 | $88,000.00 | $176,000 |
| New Clarifier Mechanism: installation | ls | 0.55 | $176,000.00 | $96,800 |
| Alum feed system: equipment | ea | 1 | $20,000.00 | $20,000 |
| Alum feed system: installation | ls | 0.45 | $20,000.00 | $9,000 |
| Rapid mix and bridge: equipment | ea | 1 | $12,500.00 | $12,500 |
| Rapid mix and bridge: installation | ls | 0.45 | $12,500.00 | $5,625 |
| Flocculator: equipment | ea | 1 | $8,000.00 | $8,000 |
| Flocculator: installation | ls | 0.45 | $8,000.00 | $3,600 |
| Alum sludge pumps (voglesan pumps 18 gpm) | ea | 2 | $10,000.00 | $20,000 |
| Alum sludge pumps: installation | ls | 0.45 | $20,000.00 | $9,000 |
| Flow meter | ea | 1 | $8,000.00 | $8,000 |
| Sludge pump piping, valve, fittings | ls | 1 | $4,000.00 | $4,000 |
| Building 20 20 | sf | 400 | $150.00 | $60,000 |
| Concrete slab with curbs for alum storage | cy | 20 | $400.00 | $8,000 |
| Concrete pit for rapid mx: 9x9x12H (10swd) | cy | 30 | $500.00 | $15,000 |
| Concrete pit for rapid mx: 15x15x16H (14swd) | cy | 55 | $500.00 | $27,500 |
| Handrail | lf | 96 | $18.00 | $1,728 |
| Grating | sf | 60 | $20.00 | $1,200 |
| Stairs | ea | 2 | $6,000.00 | $12,000 |
| Excavation and Backfill | ea | 2 | $5,500.00 | $11,000 |
| Inlet Splitter Box: 8x4x4H | | | | |
| 24" Down opening weir gates | ea | 2 | $2,000.00 | $4,000 |
| 24" Down opening weir gates: installation | ls | 0.45 | $4,000.00 | $1,800 |
| Handrail | lf | 30 | $18.00 | $540 |
| Grating | sf | 32 | $20.00 | $640 |
| Concrete | cy | 12 | $500.00 | $6,000 |
| Excavation and Backfill | ls | 1 | $3,000.00 | $3,000 |
| SUBTOTAL | | | | $662,333.00 |
| Undefined Elements 10.00% | | | | $66,233 |
| General Conditions 4.00% | | | | $26,493 |
| Mobilization & Shakedown 3.00% | | | | $19,870 |
| **TOTAL** | | | | **$774,900.00** |

PRELIMINARY COST ESTIMATE
Item M: Phosphorus Filtrate Pump Station

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 14, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| Submersible pump lift station for 287 gpm | | ls | 1 | $200,000.00 | $200,000 |
| 2 pumps installed | | | | | $0 |
| | | | | | $0 |
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| SUBTOTAL | | | | | $200,000.00 |
| Undefined Elements | 10.00% | | | | $20,000 |
| General Conditions | 4.00% | | | | $8,000 |
| Mobilization & Shakedown | 3.00% | | | | $6,000 |
| TOTAL | | | | | $234,000.00 |

PRELIMINARY COST ESTIMATE
Item N: UV Disinfection and Building

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 22, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| Concrete Structure: walls and slab | | | cy | 56 | $500.00 | $28,000 |
| Excavation | | | cy | 800 | $5.00 | $4,000 |
| Backfill | | | cy | 600 | $8.00 | $4,800 |
| Dewatering | | | ls | 1 | $6,000.00 | $6,000 |
| Building | 26 | 40 | sf | 1040 | $120.00 | $124,800 |
| UV: Equipment (2 units) | | | ea | 2 | $117,850.00 | $235,700 |
| UV: Installation | | | ls | 0.2 | $23,570.00 | $23,570 |
| Process Piping | | | | | | |
| 16" pipe for UV Units | | | ls | 1 | $24,000.00 | $24,000 |
| 20" Valves | | | ea | 4 | $14,000.00 | $56,000 |
| Flow Meter | | | ls | 1 | $12,000.00 | $12,000 |
| Washwater Pumps Installed | | | ea | 2 | $10,000.00 | $20,000 |
| Clarifier Spray Pumps Installed | | | ea | 2 | $10,000.00 | $20,000 |
| WW Piping | | | ls | 1 | $2,000.00 | $2,000 |
| SUBTOTAL | | | | | | $560,870.00 |
| Undefined Elements | | 10.00% | | | | $56,087 |
| General Conditions | | 4.00% | | | | $22,435 |
| Mobilization & Shakedown | | 3.00% | | | | $16,826 |
| TOTAL | | | | | | $656,200.00 |

PRELIMINARY COST ESTIMATE
Item Q: Yard Piping Improvements

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 21, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| | | | | | $0 |
| New Yard Piping and Valves | | ls | 1 | $375,000.00 | $375,000 |
| | | | | | $0 |
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| SUBTOTAL | | | | | $375,000.00 |
| Undefined Elements | 10.00% | | | | $37,500 |
| General Conditions | 4.00% | | | | $15,000 |
| Mobilization & Shakedown | 3.00% | | | | $11,250 |
| TOTAL | | | | | $438,800.00 |

PRELIMINARY COST ESTIMATE
Item R: Site Improvements

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 14, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| | | | | | $0 |
| New Site Improvements | | ls | 1 | $150,000.00 | $150,000 |
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| SUBTOTAL | | | | | $150,000.00 |
| Undefined Elements | 10.00% | | | | $15,000 |
| General Conditions | 4.00% | | | | $6,000 |
| Mobilization & Shakedown | 3.00% | | | | $4,500 |
| TOTAL | | | | | $175,500.00 |

PRELIMINARY COST ESTIMATE
Item S: Headworks

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 22, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| **Bar Screen Structure** | | | | | | |
| Concrete | | | cy | 90 | $500.00 | $45,000 |
| Excavation and backfill | | | ls | 1 | $9,000.00 | $9,000 |
| Painting | | | ls | 1 | $10,000.00 | $10,000 |
| Sidewalks and slab for degritter | | | ls | 1 | $14,000.00 | $14,000 |
| Grating | | | sf | 300 | $40.00 | $12,000 |
| Miscellaneous metalwork | | | ls | 1 | $6,000.00 | $6,000 |
| Stairs | | | ea | 2 | $16,000.00 | $32,000 |
| Handrail | | | lf | 200 | $18.00 | $3,600 |
| | | | | | | |
| **Aerated Grit Chamber Structure** | | | | | | |
| Concrete | | | cy | 180 | $500.00 | $90,000 |
| Excavation and backfill | | | ls | 1 | $9,000.00 | $9,000 |
| Painting | | | ls | 1 | $12,000.00 | $12,000 |
| Sidewalks | | | ls | 1 | $5,000.00 | $5,000 |
| Doors and windows | | | ls | 1 | $3,000.00 | $3,000 |
| | | | | | | |
| **Equipment** | | | | | | |
| Process piping and valves | | | ls | 1 | $18,000.00 | $18,000 |
| Mechanical bar screen | | | ls | 1.45 | $70,000.00 | $101,500 |
| Screenings, conveyor/compactor | | | ls | 1.45 | $25,000.00 | $36,250 |
| Aeration grit chamber equipment | | | ls | 1.45 | $30,000.00 | $43,500 |
| Aeration grit blowers | | | ls | 1.45 | $11,300.00 | $16,385 |
| Add cyclone to existing grit classifier | | | ls | 1.45 | $15,000.00 | $21,750 |
| Relocate existing grit classifier | | | ls | 1 | $2,000.00 | $2,000 |
| Grit air lift pumps | | | ls | 1.45 | $30,000.00 | $43,500 |
| Manual bar screen | | | ls | 1.45 | $5,000.00 | $7,250 |
| 30" W slide gates | 5000 | 6 | ls | 1.45 | $30,000.00 | $43,500 |
| 30" sluice gate flange end | | | ls | 1.45 | $9,000.00 | $13,050 |
| Stainless steel chute | | | ls | 1.45 | $1,500.00 | $2,175 |
| | | | | | | |
| 30" DIP | | | lf | 40 | $100.00 | $4,000 |
| SUBTOTAL | | | | | | $603,460.00 |
| Undefined Elements | 10.00% | | | | | $60,346 |
| General Conditions | 4.00% | | | | | $24,138 |
| Mobilization & Shakedown | 3.00% | | | | | $18,104 |
| TOTAL | | | | | | $706,000.00 |

PRELIMINARY COST ESTIMATE
Item T: RAS & WAS Pump Station

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 16, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| **Concrete (slab, footings, pipe trenches)** | | | | | | |
| Wall and slabs | | | cy | 64 | $400.00 | $25,600 |
| Building | 40 | 40 | sf | 1600 | $120.00 | $192,000 |
| **Equipment** | | | | | | |
| RAS pumps (1,300 gpm), valves and accessories | | | ea | 3 | $36,679.00 | $110,037 |
| WAS pumps (100 gpm), valves and accessories | | | ea | 2 | $8,600.00 | $17,200 |
| Subtotal | | | | | | |
| Pump Installation | | | ls | 0.55 | $127,237.00 | $69,980 |
| Valves and flow meters | | | ls | 1 | $20,000.00 | $20,000 |
| Crane | | | ls | 1 | $18,000.00 | $18,000 |
| Piping and fittings | | | ls | 1 | $40,000.00 | $40,000 |
| Painting | | | ls | 1 | $15,000.00 | $15,000 |
| SUBTOTAL | | | | | | $507,817.35 |
| Undefined Elements | | 10.00% | | | | $50,782 |
| General Conditions | | 4.00% | | | | $20,313 |
| Mobilization & Shakedown | | 3.00% | | | | $15,235 |
| TOTAL | | | | | | $594,100.00 |

PRELIMINARY COST ESTIMATE
Alternative 1 Conventional Biological Nutrient Removal
Item V: Laboratory and Administration/Control Building
DATE: Dec 29, 2004

| ITEM | | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|---|
| Building | 60 | 40 | | sf | 2400 | $400.00 | $960,000 |
| | | | | | | | $0 |
| Control Room Area | | 30 | 30 | sf | 900 | $220.00 | $198,000 |
| | | | | | | | $0 |
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| SUBTOTAL | | | | | | | $1,158,000.00 |
| Undefined Elements | | 10.00% | | | | | $115,800 |
| General Conditions | | 4.00% | | | | | $46,320 |
| Mobilization & Shakedown | | 3.00% | | | | | $34,740 |
| TOTAL | | | | | | | $1,354,900.00 |

PRELIMINARY COST ESTIMATE
Item U: Laboratory Testing Services

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 14, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| | | | | $0 |
| Laboratory Services | ea | 1 | $100,000.00 | $100,000 |
| | | | | $0 |
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| SUBTOTAL | | | | $100,000.00 |
| Undefined Elements | | | | $0 |
| General Conditions | | | | $0 |
| Mobilization & Shakedown | | | | $0 |
| TOTAL | | | | $100,000.00 |

PRELIMINARY COST ESTIMATE
Item W: Demolition

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 22, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| **Stage 1 and Stage 2** | | | | | | |
| Concrete slabs | | | cy | 1059 | | |
| Concrete walls | total | 3171 | cy | 2112 | | |
| Fill materials | | | cy | 12852 | | |
| **Estimated time to demolish the following structures** | | | | | | |
| Gravity thickener | | | days | 10 | | |
| Influent screw pump station | | | days | 40 | | |
| RAS screw pump station | | | days | 50 | | |
| Head works | | | days | 40 | | |
| Splitter structure | | | days | 30 | | |
| | Subtotal Stage 2 | | | 160 | | |
| **Demolition Crew** | | | | | | |
| Foreman | | | day | 1 | $400.00 | |
| Labor 1 | | | day | 1 | $250.00 | |
| Labor 2 | | | day | 1 | $250.00 | |
| | | | day | Subtotal | $900.00 | |
| **Demolition Equipment** | | | | | | |
| 400 PCL-6 Excavator (SJLouis) | | | day | 1 | $1,200.00 | |
| Hydraulic Impact Breaker (SJLouis) | | | day | 1 | $800.00 | |
| Caterpillar 950 Wheel loader (SJLouis) | | | day | 1 | $460.00 | |
| Demolition Equipment Operator 1 | | | day | 1 | $400.00 | |
| Demolition Equipment Operator 2 | | | day | 1 | $400.00 | |
| Demolition Equipment Operator 3 | | | day | 1 | $400.00 | |
| | | | day | Subtotal | $3,660.00 | |
| **Hauling Equipment** | | | | | | |
| 25 ton dump truck | | | day | 1 | $600.00 | |
| Truck driver | | | day | 1 | $320.00 | |
| 25 ton crane | | | day | 1 | $680.00 | |
| 25 ton crane operator | | | day | 1 | $400.00 | |
| | | | day | Subtotal | $2,000.00 | |
| **Demolition Costs: Gravity Thickener** | | | | | | |
| Labor | | | days | 10 | $900.00 | $9,000 |
| Demolition Equipment | | | days | 10 | $3,660.00 | $36,600 |
| Hauling Equipment | | | days | 10 | $2,000.00 | $20,000 |
| **Hauling Costs to Roswell Landfill** | | | miles | | | |
| Gravity Thickener | cy | cy per trk | | | | |
| Number trips | 125 | 30 4 | | | | |
| Miles | 130 | 4 | miles | 542 | $8.00 | $4,333 |
| **Landfill Charges** | $10.00 per ton | | ton | 43 | $10.00 | $428 |
| 0.0135 ton/cy | | | | | | |

| ITEM | | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|---|
| **Demolition Costs: Stage 2** | | | | | | | |
| Labor | | | | days | 160 | $900.00 | $144,000 |
| Demolition Equipment | | | | days | 160 | $3,660.00 | $585,600 |
| Hauling Equipment | | | | days | 160 | $2,000.00 | $320,000 |
| **Hauling Costs to Roswell Landfill** | | | | miles | | | |
| Stage 2 | cy | cy per trk | | | | | |
| Number trips | 3171 | 30 | 106 | | | | |
| Miles | 130 | 106 | | miles | 13741 | $8.00 | $109,928 |
| **Backfilling Costs** | | | | | | | |
| Stage 1 | | | | cy | 652 | $2.00 | $1,304 |
| Stage 2 | | | | cy | 12852 | $2.00 | $25,704 |
| **Removal and capping of existing piping** | | | | ls | 1 | $60,000.00 | $60,000 |
| **Electrical Demolition** | | | | hours | 30 | $1,000.00 | $30,000 |
| SUBTOTAL | | | | | | | $1,346,897.42 |
| Undefined Elements | | | | | | | $0 |
| General Conditions | | 4.00% | | | | | $53,876 |
| Mobilization & Shakedown | | 3.00% | | | | | $40,407 |

| | |
|---|---|
| TOTAL | $1,441,200.00 |

PRELIMINARY COST ESTIMATE
Item X: Building In lieu of Canopy

Alternative 1 Conventional Biological Nutrient Removal
DATE: Dec 29, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| | | | | | | $0 |
| Building Size | 60 | 60 | sf | 3600 | $180.00 | $648,000 |
| | | | | | | $0 |
| | | | | | | $0 |
| less: | | | | | | $0 |
| Canopy Cover Structure | | | sf | -3600 | $30.00 | ($108,000) |
| Site Preparation | | | ls | -1 | $10,000.00 | ($10,000) |
| | | | | | | $0 |
| | | | | | | $0 |
| | | | | | | $0 |
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| | | | | | | $0 |
| | | | | | | $0 |
| | | | | | | $0 |
| | | | | | | $0 |
| SUBTOTAL | | | | | | $530,000.00 |
| Undefined Elements | | 10.00% | | | | $53,000 |
| General Conditions | | 4.00% | | | | $21,200 |
| Mobilization & Shakedown | | 3.00% | | | | $15,900 |
| TOTAL | | | | | | $620,100.00 |

PRELIMINARY COST ESTIMATE
Item Z: Operating Costs

Alternative 1 Conventional Biological Nutrient Removal
DATE: 30-Dec-04

| ITEM | QUANT | UNIT PRICE ($/kWh) | COST ESTIMATE ($/yr) |
|---|---|---|---|
| Influent Pumps | 725.28 | $0.08 | $21,193 |
| Bar Screen | 11.4 | $0.08 | $333 |
| Screenings Conveyor/Compactor | 15.05 | $0.08 | $440 |
| Grit Classifier | 7.6 | $0.08 | $222 |
| Grit Lift Pumps | 30.43 | $0.08 | $889 |
| Aerated Grit Blowers | 204.11 | $0.08 | $5,964 |
| Anaerobic Selector Mixers | 91.2 | $0.08 | $2,665 |
| Anoxic Selector Mixers | 365.24 | $0.08 | $10,672 |
| Aeration Basin Blowers | 5013.12 | $0.08 | $146,483 |
| Final Clarifiers | 12 | $0.08 | $351 |
| UV Units | 1440 | $0.08 | $42,077 |
| Aerobic Digester Blowers | 2341.84 | $0.08 | $68,429 |
| Returns Rapid Mixer | 115.2 | $0.08 | $3,366 |
| Returns Flocculator | 15.12 | $0.08 | $442 |
| Returns Clarifiers | 12 | $0.08 | $351 |
| RAS Pumps | 544.28 | $0.08 | $15,904 |
| Scum Pumps | 60.88 | $0.08 | $1,779 |
| WAS Pumps | 14.21 | $0.08 | $415 |
| Thickened Sludge Pump | 2.56 | $0.08 | $75 |
| Digested Sludge Pump | 4.57 | $0.08 | $134 |
| Alum Sludge Pump | 9.89 | $0.08 | $289 |
| Returns Pump | 29.05 | $0.08 | $849 |
| Chemical Feed Pumps | 24 | $0.08 | $701 |
| Belt Thickener | 40 | $0.08 | $1,169 |
| Belt Press | 31 | $0.08 | $906 |

| | | |
|---|---|---|
| Subtotal System Operation | $ | 326,096 |
| Subtotal System Maintenance (Estimate 1% of capital cost) | $ | 258,970 |
| **Total O&M Cost ($/yr)** | **$** | **585,066** |

| | | |
|---|---|---|
| TOTAL ($/yr) | $ | 585,066 |
| Present Worth | $ | 8,705,783 |

# APPENDIX E

# ALTERNATIVE 2
# SINGLE BASIN NITRIFICATION/DENITRIFICATION

# CONCEPTUAL PROJECT COSTS

# ALTERNATIVE 2 - SINGLE BASIN NITRIFICATION/DENITRIFICATION
# CONCEPTUAL PROJECT COSTS
# WASTEWATER TREATMENT PLANT IMPROVEMENTS

| | Amount |
|---|---|
| **Construction Costs** | |
| Anaerobic Selector | $559,000 |
| Aeration Basin and Blowers/Canopy Structure | $3,986,000 |
| Influent Pump Station | $1,332,000 |
| Secondary Clarifiers | $1,520,000 |
| Mechanical Dewatering Facilities | $1,776,000 |
| Aerobic Digester and Blower Structure | $1,227,000 |
| Chemical Precipitation Filtrate - Phosphorus Removal | $775,000 |
| Phosphorus Filtrate Pump Station | $234,000 |
| UV Disinfection Building | $656,000 |
| Yard Piping Improvements | $439,000 |
| Site Improvements | $176,000 |
| Headworks | $706,000 |
| RAS/WAS Pump Station | $594,000 |
| Laboratory and Administration/Control Building | $1,355,000 |
| Electrical | $1,840,000 |
| Laboratory Testing Services | $100,000 |
| Subtotal | $17,275,000 |
| Other Support Facilities: | |
| Building in lieu of Canopy | $620,000 |
| Demolition | $1,441,000 |
| Subtotal | $2,061,000 |
| Subtotal of New Facilities | $19,336,000 |
| Construction Contingencies @ 10% | $1,934,000 |
| Subtotal | $21,270,000 |
| NMGRT @ 7.6875% | $1,635,000 |
| Total Construction Costs | $22,905,000 |
| **Professional Engineering Services Allowance @ 9.5%** | |
| Basic design services and allowance for special services including construction inspection (18 months), soils investigation, surveys, aerial mapping, operation and maintanance manual, and startup services | $2,176,000 |
| NMGRT @ 6.75% | $147,000 |
| Total Professional Engineering Services | $2,323,000 |
| **Total Project Costs** | $25,228,000 |

## CONSTRUCTION COST ESTIMATE
## ALTERNATIVE 2 SINGLE BASIN NITRIFICATION AND DENITRIFICATION

COST SUMMARY
MOLZEN-CORBIN & ASSOCIATES
JOB NO: RUI 21-71.D03

PREPARED BY: A. Campos
PRINT DATE:
DATE PREPARED: 1/10/2005

| ITEM | DESIGN COST ESTIMATE |
|---|---|
| Item D: Anaerobic Selector | $559,200 |
| Item E: Aeration Basin and Blowers/Canopy Structure | $3,985,700 |
| Item F: Influent Pump Station | $1,331,700 |
| Item G: Secondary Clarifiers | $1,519,800 |
| Item J: Mechanical Dewatering Building | $1,775,900 |
| Item K: Aerobic Digester and Blower Structure | $1,227,300 |
| Item L: Chemical Precipitation Filtration - Phosphorus Removal | $774,900 |
| Item M: Phosphorus Filtrate Pump Station | $234,000 |
| Item N: UV Disinfection and Building | $656,200 |
| Item Q: Yard Piping Improvements | $438,800 |
| Item R: Site Improvements | $175,500 |
| Item S: Headworks | $706,000 |
| Item T: RAS & WAS Pump Station | $594,100 |
| Item V: Laboratory and Administration/Control Building | $1,354,900 |
| Electrical | $1,840,100 |
| Item U: Laboratory Testing Services | $100,000 |
| Item W: Demolition | $1,441,200 |
| Item X: Building Inlieu of Canopy | $620,100 |
| SUBTOTAL | $19,335,400 |
| Construction Contingencies 10.00% | $1,933,540 |
| TOTAL | $21,268,940 |
| STATE TAX (construction) 7.68750% | $1,635,050 |
| TOTAL ESTIMATED CONSTRUCTION COSTS | $22,903,990 |

PRELIMINARY COST ESTIMATE    Alternative 2: Single Basin Nitrification/Denitrification
Item D: Anaerobic Selector    DATE: Dec 20, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **28x52x24 (22'SWD)** | | | | |
| Concrete Walls | cy | 280 | $500.00 | $140,000 |
| Concrete Floor | cy | 100 | $500.00 | $50,000 |
| Excavation | cy | 900 | $10.00 | $9,000 |
| Backfill and compaction | cy | 400 | $12.00 | $4,800 |
| Interior Painting | ls | 7100 | $4.00 | $28,400 |
| Exterior Painting | ls | 3100 | $4.00 | $12,400 |
| Stairways and platform | ea | 3 | $12,000.00 | $36,000 |
| Miscellaneous metal works | ls | 1 | $6,000.00 | $6,000 |
| **Equipment** | | | | |
| Mechanical Mixer: Equipment | ea | 4 | $20,250.00 | $81,000 |
| Mechanical Mixer: Installation | ls | 0.35 | $81,000.00 | $28,350 |
| Support bridges for mixers w/ grating & handrail | ea | 4 | $7,500.00 | $30,000 |
| Support bridges for mixers: installation | ls | 0.35 | $30,000.00 | $10,500 |
| Structure Piping: 30" | lf | 30 | $100.00 | $3,000 |
| Structure Piping: 18" RAS | lf | 15 | $60.00 | $900 |
| 30" Bypass piping | lf | 70 | $100.00 | $7,000 |
| Slide gates with installation | ea | 3 | $7,000.00 | $21,000 |
| **Alkalinity Augmentation** | | | | |
| Place metering pumps, piping and chemical storage in Headworks Structure | | | | |
| Liquid soda ash feed pumps: equipment | ea | 2 | $2,000.00 | $4,000 |
| Liquid soda ash feed pumps: installation | ls | 0.5 | $4,000.00 | $2,000 |
| Piping | lf | 40 | $10.00 | $400 |
| Misc valves and support | ls | 1 | $200.00 | $200 |
| | | | | $0 |
| Soda Ash Containment Area Liner | ls | 1 | $3,000.00 | $3,000 |
| | | | | $0 |
| SUBTOTAL | | | | $477,950.00 |
| Undefined Elements 10.00% | | | | $47,795 |
| General Conditions 4.00% | | | | $19,118 |
| Mobilization & Shakedown 3.00% | | | | $14,339 |
| TOTAL | | | | $559,200.00 |

PRELIMINARY COST ESTIMATE Alternative 2: Single Basin Nitrification/Denitrification
Item E: Aeration Basin and Blowers/Canopy Structure DATE: Dec 22, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **Aeration Basin Structure: 100L x 140 x 24 (22 SWD)** | | | | |
| Concrete walls | cy | 1040 | $500.00 | $520,000 |
| Concrete floor | cy | 890 | $500.00 | $445,000 |
| Concrete walkway | cy | 20 | $500.00 | $10,000 |
| Inlet and outlet boxes | cy | 60 | $500.00 | $30,000 |
| Excavation | cy | 12900 | $10.00 | $129,000 |
| Backfill | cy | 3100 | $12.00 | $37,200 |
| Miscellaneous metal works | ls | 1 | $25,000.00 | $25,000 |
| Painting Interior | sf | 22400 | $4.00 | $89,600 |
| Painting Exterior | sf | 6700 | $4.00 | $26,800 |
| Stairways | ea | 2 | $12,000.00 | $24,000 |
| Hand Rail | lf | 340 | $18.00 | $6,120 |
| **Piping** | | | | |
| Air Piping Header (16") HDG | lf | 250 | $70.00 | $17,500 |
| Air Piping Header (12") HDG | lf | 160 | $60.00 | $9,600 |
| Air Piping Header (12") HDG | lf | 80 | $50.00 | $4,000 |
| Misc air piping supports, etc | ls | 1 | $8,000.00 | $8,000 |
| Drain Piping and valves | lf | 200 | $60.00 | $12,000 |
| **Aeration Basin Equipment** | | | | |
| Air bridges (4), shear tubes, valves: equipment | ls | 1 | $343,000 | $343,000 |
| Air bridges, shear tubes, etc: installation | ls | 0.45 | $343,000 | $154,350 |
| Adder for air bridges 4 18750 | ea | 1.3 | $75,000 | $97,500 |
| Symbio Control | ls | 1.2 | $200,000 | $240,000 |
| 48" W Down opening weir gates: equipment | ea | 2 | $6,400 | $12,800 |
| 48" W Down opening weir gates: installation | ls | 0.45 | $12,800 | $5,760 |
| 36" W Down opening weir gates: equipment | ls | 3 | $3,600 | $10,800 |
| 36" W Down opening weir gates: installation | ls | 0.45 | $10,800 | $4,860 |
| Scum removal telescoping pan | ls | 1.45 | $3,000 | $4,350 |
| **Blower Structure** | | | | |
| Blower and accessories: equipment (6 blowers) | ls | 1 | $282,000 | $282,000 |
| Blower and accessories: installation | ls | 0.35 | $98,700 | $98,700 |
| Air Piping Header (24") HDG | lf | 80 | $120.00 | $9,600 |
| Blower piping and valves | ls | 1 | $55,000.00 | $55,000 |
| Canopy Cover Structure 80x60 | sf | 4800 | $30.00 | $144,000 |
| Site preparation | ls | 1 | $10,000.00 | $10,000 |
| Emergency Generator | ls | 1.35 | $400,000.00 | $540,000 |
| SUBTOTAL | | | | $3,406,540.00 |
| Undefined Elements 10.00% | | | | $340,654 |
| General Conditions 4.00% | | | | $136,262 |
| Mobilization & Shakedown 3.00% | | | | $102,196 |
| TOTAL | | | | $3,985,700.00 |

PRELIMINARY COST ESTIMATE
Item F: Influent Pump Station

Alternative 2: Single Basin Nitrification/Denitrification

DATE: Dec 29, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| **Lift Station Structure** | | | | | |
| Wet well structure | 20L x 12W x 20D | cy | 1208 | $500.00 | $604,000 |
| Excavation | | cy | 1720 | $10.00 | $17,200 |
| Backfill | | cy | 1440 | $12.00 | $17,280 |
| Metal Work (includes hoist structure) | | ls | 1 | $20,000.00 | $20,000 |
| Valve Pit Structure | | ls | 1 | $30,000.00 | $30,000 |
| Dewatering | | ls | 1 | $25,000.00 | $25,000 |
| **Equipment** | | | | | |
| 3 submersible pumps and accessories | | ls | 1.55 | $118,820.00 | $184,171 |
| Installation of well well piping | | ls | 1 | $40,000.00 | $40,000 |
| Wet well fan and accessories | | ls | 1 | $10,000.00 | $10,000 |
| Piping in wetwell and valve pit | | ls | 1 | $26,000.00 | $26,000 |
| Inlet Sewer | | ls | 1 | $12,000.00 | $12,000 |
| Crane | | ls | 1 | $26,000.00 | $26,000 |
| Forcemain header | | ls | 1 | $24,000.00 | $24,000 |
| Painting Interior | | sf | 1350 | $8.00 | $10,800 |
| Painting Exterior | | sf | 480 | $4.00 | $1,920 |
| Painting Top Deck | | sf | 240 | $4.00 | $960 |
| 18" Flow Meter | | ls | 1.9 | $4,655.00 | $8,845 |
| Building for Electrical Equipment | | sf | 400 | $200.00 | $80,000 |
| SUBTOTAL | | | | | $1,138,175.50 |
| Undefined Elements | 10.00% | | | | $113,818 |
| General Conditions | 4.00% | | | | $45,527 |
| Mobilization & Shakedown | 3.00% | | | | $34,145 |
| TOTAL | | | | | $1,331,700.00 |

PRELIMINARY COST ESTIMATE
Item G: Secondary Clarifiers

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 20, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **80' Clarifier Structure (each)** | | | | |
| Concrete Walls | cy | 252 | $500.00 | $126,000 |
| Concrete Floor | cy | 280 | $500.00 | $140,000 |
| Concrete Walkway | cy | 8 | $500.00 | $4,000 |
| Stairs | ls | 1 | $2,000.00 | $2,000 |
| Walkway Handrailing | lf | 18 | $500.00 | $9,000 |
| Excavation | cy | 7200 | $10.00 | $72,000 |
| Backfill and compaction | cy | 2300 | $12.00 | $27,600 |
| Interior Painting | ls | 1200 | $6.00 | $7,200 |
| Exterior Painting | ls | 1200 | $4.00 | $4,800 |
| Miscellaneous piping | ls | 1 | $12,000.00 | $12,000 |
| Clarifier Equipment and Accessories: equipment | ls | 1 | $158,000.00 | $158,000 |
| Clarifier Equipment and Accessories: installation | ls | 0.55 | $158,000.00 | $86,900 |
| 2nd Clarifier | ls | 1 | $649,500.00 | $649,500 |
| SUBTOTAL | | | | $1,299,000.00 |
| Undefined Elements 10.00% | | | | $129,900 |
| General Conditions 4.00% | | | | $51,960 |
| Mobilization & Shakedown 3.00% | | | | $38,970 |
| TOTAL | | | | $1,519,800.00 |

PRELIMINARY COST ESTIMATE
Item J: Mechanical Dewatering Building

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 15, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| Dewatering Structure | | | | | | |
| Building | 60 | 85 | sf | 5100 | $150.00 | $765,000 |
| Thickening Belt, SS Frame | | | ls | 1 | $118,000.00 | $118,000 |
| Thickening Belt: installation | | | ls | 0.2 | $23,600.00 | $23,600 |
| Control Panel | | | ls | 1 | $30,000.00 | $30,000 |
| Alum platform and stairs | | | ls | 1 | $25,000.00 | $25,000 |
| Alum platform and stairs: installation | | | ls | 0.35 | $8,750.00 | $8,750 |
| Thickened sludge hopper | | | ls | 1 | $5,000.00 | $5,000 |
| Thickened sludge hopper: installation | | | ls | 0.35 | $1,750.00 | $1,750 |
| Polymer system: equipment | | | ls | 1 | $16,000.00 | $16,000 |
| Polymer system: installation | | | ls | 0.45 | $7,200.00 | $7,200 |
| Dewatering Belt, SS Frame | | | ls | 1 | $262,500.00 | $262,500 |
| Thickening Belt: installation | | | ls | 0.2 | $52,500.00 | $52,500 |
| Control Panel | | | ls | 1 | $40,000.00 | $40,000 |
| Alum platform and stairs | | | ls | 1 | $25,000.00 | $25,000 |
| Alum platform and stairs: installation | | | ls | 0.35 | $8,750.00 | $8,750 |
| Conveyor system | | | ls | 1 | $37,000.00 | $37,000 |
| Conveyor system: installation | | | ls | 0.45 | $16,650.00 | $16,650 |
| Polymer system: equipment | | | ls | 1 | $16,000.00 | $16,000 |
| Polymer system: installation | | | ls | 0.45 | $7,200.00 | $7,200 |
| Thickened Sludge Pumps (Voglesand) | | | ea | 2 | $10,000.00 | $20,000 |
| Thickened Sludge Pumps: installation | | | ls | 0.35 | $20,000.00 | $7,000 |
| Flow meter | | | ls | 1 | $8,000.00 | $8,000 |
| Piping, fittings, valves | | | ls | 1 | $7,000.00 | $7,000 |
| Miscellaneous Metal Works | | | ls | 1 | $4,000.00 | $4,000 |
| Washwater piping system | | | ls | 1 | $6,000.00 | $6,000 |
| SUBTOTAL | | | | | | $1,517,900.00 |
| Undefined Elements | | 10.00% | | | | $151,790 |
| General Conditions | | 4.00% | | | | $60,716 |
| Mobilization & Shakedown | | 3.00% | | | | $45,537 |
| TOTAL | | | | | | $1,775,900.00 |

PRELIMINARY COST ESTIMATE
Item K: Aerobic Digester and Blower Structure

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 21, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **Size: 28x28x22 swd (three basins total)** | | | | |
| Equipment for Basin | | | | |
| Process aeration equipment | ls | 1.45 | $135,000.00 | $195,750 |
| 8" telescoping valves and controls (3 total) | ls | 1.45 | $28,000.00 | $40,600 |
| Platforms and stairs | ls | 1 | $20,000.00 | $20,000 |
| Down opening weir gates | ea | 4 | $4,000.00 | $16,000 |
| Handrail | lf | 120 | $18.00 | $2,160 |
| Basin Structure | | | | |
| Concrete Walls | cy | 385 | $500.00 | $192,500 |
| Concrete Floor | cy | 165 | $500.00 | $82,500 |
| Concrete walkway | cy | 5 | $500.00 | $2,500 |
| Excavation and Backfill | ls | 1 | $4,000.00 | $4,000 |
| Interior coating system | sf | 8070 | $4.00 | $32,280 |
| Exterior coating system | sf | 4720 | $4.00 | $18,880 |
| 10" air piping and valves 3 each | lf | 80 | $50.00 | $4,000 |
| 8" supernatant drain line | lf | 30 | $40.00 | $1,200 |
| 8" supernatant drain shutoff valves | ea | 3 | $400.00 | $1,200 |
| Blower and Digested Pump Structure | | | | |
| Building 40 30 | sf | 1200 | $150.00 | $180,000 |
| PD blowers: equipment 4 total | ls | 1 | $131,500.00 | $131,500 |
| PD blowers: installation | ls | 0.45 | $59,175.00 | $59,175 |
| Blower piping and valves (8" discharge to 16" header | ls | 1 | $15,000.00 | $15,000 |
| Blower shut off valves | ea | 4 | $400.00 | $1,600 |
| Blower check valves | ea | 4 | $300.00 | $1,200 |
| Digested Sludge Pumps (Voglesand) | ea | 2 | $11,000.00 | $22,000 |
| Digested Sludge Pumps: installation | ls | 0.45 | $22,000.00 | $9,900 |
| Flow meter | ls | 1 | $8,000.00 | $8,000 |
| Piping, fittings, valves | ls | 1 | $7,000.00 | $7,000 |
| SUBTOTAL | | | | $1,048,945.00 |
| Undefined Elements 10.00% | | | | $104,895 |
| General Conditions 4.00% | | | | $41,958 |
| Mobilization & Shakedown 3.00% | | | | $31,468 |
| TOTAL | | | | $1,227,300.00 |

PRELIMINARY COST ESTIMATE
Item L: Chemical Precipilation Filtration - Phosphorus Removal

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 20, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **Equipment Removal** | | | | |
| Remove clarifier equipment and center column | crew-day | 10 | $2,000.00 | $20,000 |
| Remove clarifier equipment and center column | crew-day | 10 | $2,000.00 | $20,000 |
| | | | | |
| Structure Improvements | ea | 2 | $25,000.00 | $50,000 |
| Interior painting | ea | 3000 | $7.00 | $21,000 |
| Exterior painting | ea | 1400 | $6.00 | $8,400 |
| Miscellaneous piping | ea | 2 | $9,000.00 | $18,000 |
| | | | | |
| **Equipment** | | | | |
| New Clarifier Mechanism: equipment | ea | 2 | $88,000.00 | $176,000 |
| New Clarifier Mechanism: installation | ls | 0.55 | $176,000.00 | $96,800 |
| Alum feed system: equipment | ea | 1 | $20,000.00 | $20,000 |
| Alum feed system: installation | ls | 0.45 | $20,000.00 | $9,000 |
| Rapid mix and bridge: equipment | ea | 1 | $12,500.00 | $12,500 |
| Rapid mix and bridge: installation | ls | 0.45 | $12,500.00 | $5,625 |
| Flocculator: equipment | ea | 1 | $8,000.00 | $8,000 |
| Flocculator: installation | ls | 0.45 | $8,000.00 | $3,600 |
| Alum sludge pumps (voglesan pumps 18 gpm) | ea | 2 | $10,000.00 | $20,000 |
| Alum sludge pumps: installation | ls | 0.45 | $20,000.00 | $9,000 |
| Flow meter | ea | 1 | $8,000.00 | $8,000 |
| Sludge pump piping, valve, fittings | ls | 1 | $4,000.00 | $4,000 |
| | | | | |
| Building 20 20 | sf | 400 | $150.00 | $60,000 |
| Concrete slab with curbs for alum storage | cy | 20 | $400.00 | $8,000 |
| Concrete pit for rapid mx: 9x9x12H (10swd) | cy | 30 | $500.00 | $15,000 |
| Concrete pit for rapid mx: 15x15x16H (14swd) | cy | 55 | $500.00 | $27,500 |
| Handrail | lf | 96 | $18.00 | $1,728 |
| Grating | sf | 60 | $20.00 | $1,200 |
| Stairs | ea | 2 | $6,000.00 | $12,000 |
| Excavation and Backfill | ea | 2 | $5,500.00 | $11,000 |
| | | | | |
| Inlet Splitter Box: 8x4x4H | | | | |
| 24" Down opening weir gates | ea | 2 | $2,000.00 | $4,000 |
| 24" Down opening weir gates: installation | ls | 0.45 | $4,000.00 | $1,800 |
| Handrail | lf | 30 | $18.00 | $540 |
| Grating | sf | 32 | $20.00 | $640 |
| Concrete | cy | 12 | $500.00 | $6,000 |
| Excavation and Backfill | ls | 1 | $3,000.00 | $3,000 |
| SUBTOTAL | | | | $662,333.00 |
| Undefined Elements 10.00% | | | | $66,233 |
| General Conditions 4.00% | | | | $26,493 |
| Mobilization & Shakedown 3.00% | | | | $19,870 |
| **TOTAL** | | | | $774,900.00 |

PRELIMINARY COST ESTIMATE
Item M: Phosphorus Filtrate Pump Station

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 14, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| Submersible pump lift station for 287 gpm | | ls | 1 | $200,000.00 | $200,000 |
| 2 pumps installed | | | | | $0 |
| | | | | | $0 |
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| | | | | | $0 |
| SUBTOTAL | | | | | $200,000.00 |
| Undefined Elements | 10.00% | | | | $20,000 |
| General Conditions | 4.00% | | | | $8,000 |
| Mobilization & Shakedown | 3.00% | | | | $6,000 |
| TOTAL | | | | | $234,000.00 |

PRELIMINARY COST ESTIMATE
Item N: UV Disinfection and Building

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 22, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| Concrete Structure: walls and slab | | | cy | 56 | $500.00 | $28,000 |
| Excavation | | | cy | 800 | $5.00 | $4,000 |
| Backfill | | | cy | 600 | $8.00 | $4,800 |
| Dewatering | | | ls | 1 | $6,000.00 | $6,000 |
| Building | 26 | 40 | sf | 1040 | $120.00 | $124,800 |
| UV: Equipment (2 units) | | | ea | 2 | $117,850.00 | $235,700 |
| UV: Installation | | | ls | 0.2 | $23,570.00 | $23,570 |
| Process Piping | | | | | | |
| 16" pipe for UV Units | | | ls | 1 | $24,000.00 | $24,000 |
| 20" Valves | | | ea | 4 | $14,000.00 | $56,000 |
| Flow Meter | | | ls | 1 | $12,000.00 | $12,000 |
| Washwater Pumps Installed | | | ea | 2 | $10,000.00 | $20,000 |
| Clarifier Spray Pumps Installed | | | ea | 2 | $10,000.00 | $20,000 |
| WW Piping | | | ls | 1 | $2,000.00 | $2,000 |
| SUBTOTAL | | | | | | $560,870.00 |
| Undefined Elements | 10.00% | | | | | $56,087 |
| General Conditions | 4.00% | | | | | $22,435 |
| Mobilization & Shakedown | 3.00% | | | | | $16,826 |
| TOTAL | | | | | | $656,200.00 |

PRELIMINARY COST ESTIMATE
Item Q: Yard Piping Improvements

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 21, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| New Yard Piping and Valves | | ls | 1 | $375,000.00 | $375,000 |
| | | | | | $0 |
| | | | | | $0 |
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| SUBTOTAL | | | | | $375,000.00 |
| Undefined Elements | 10.00% | | | | $37,500 |
| General Conditions | 4.00% | | | | $15,000 |
| Mobilization & Shakedown | 3.00% | | | | $11,250 |
| TOTAL | | | | | $438,800.00 |

PRELIMINARY COST ESTIMATE
Item R: Site Improvements

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 14, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| New Site Improvements | | ls | 1 | $150,000.00 | $150,000 |
| | | | | | $0 |
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| SUBTOTAL | | | | | $150,000.00 |
| Undefined Elements | 10.00% | | | | $15,000 |
| General Conditions | 4.00% | | | | $6,000 |
| Mobilization & Shakedown | 3.00% | | | | $4,500 |
| TOTAL | | | | | $175,500.00 |

PRELIMINARY COST ESTIMATE
Item S: Headworks

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 22, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| **Bar Screen Structure** | | | | | | |
| Concrete | | | cy | 90 | $500.00 | $45,000 |
| Excavation and backfill | | | ls | 1 | $9,000.00 | $9,000 |
| Painting | | | ls | 1 | $10,000.00 | $10,000 |
| Sidewalks and slab for degritter | | | ls | 1 | $14,000.00 | $14,000 |
| Grating | | | sf | 300 | $40.00 | $12,000 |
| Miscellaneous metalwork | | | ls | 1 | $6,000.00 | $6,000 |
| Stairs | | | ea | 2 | $16,000.00 | $32,000 |
| Handrail | | | lf | 200 | $18.00 | $3,600 |
| **Aerated Grit Chamber Structure** | | | | | | |
| Concrete | | | cy | 180 | $500.00 | $90,000 |
| Excavation and backfill | | | ls | 1 | $9,000.00 | $9,000 |
| Painting | | | ls | 1 | $12,000.00 | $12,000 |
| Sidewalks | | | ls | 1 | $5,000.00 | $5,000 |
| Doors and windows | | | ls | 1 | $3,000.00 | $3,000 |
| **Equipment** | | | | | | |
| Process piping and valves | | | ls | 1 | $18,000.00 | $18,000 |
| Mechanical bar screen | | | ls | 1.45 | $70,000.00 | $101,500 |
| Screenings, conveyor/compactor | | | ls | 1.45 | $25,000.00 | $36,250 |
| Aeration grit chamber equipment | | | ls | 1.45 | $30,000.00 | $43,500 |
| Aeration grit blowers | | | ls | 1.45 | $11,300.00 | $16,385 |
| Add cyclone to existing grit classifier | | | ls | 1.45 | $15,000.00 | $21,750 |
| Relocate existing grit classifier | | | ls | 1 | $2,000.00 | $2,000 |
| Grit air lift pumps | | | ls | 1.45 | $30,000.00 | $43,500 |
| Manual bar screen | | | ls | 1.45 | $5,000.00 | $7,250 |
| 30" W slide gates | 5000 | 6 | ls | 1.45 | $30,000.00 | $43,500 |
| 30" sluice gate flange end | | | ls | 1.45 | $9,000.00 | $13,050 |
| Stainless steel chute | | | ls | 1.45 | $1,500.00 | $2,175 |
| 30" DIP | | | lf | 40 | $100.00 | $4,000 |
| SUBTOTAL | | | | | | $603,460.00 |
| Undefined Elements | | 10.00% | | | | $60,346 |
| General Conditions | | 4.00% | | | | $24,138 |
| Mobilization & Shakedown | | 3.00% | | | | $18,104 |
| TOTAL | | | | | | $706,000.00 |

PRELIMINARY COST ESTIMATE
Item T: RAS & WAS Pump Station

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 16, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| **Concrete (slab, footings, pipe trenches)** | | | | | | |
| Wall and slabs | | | cy | 64 | $400.00 | $25,600 |
| | | | | | | $0 |
| Building | 40 | 40 | sf | 1600 | $120.00 | $192,000 |
| **Equipment** | | | | | | |
| RAS pumps (1,300 gpm), valves and accessories | | | ea | 3 | $36,679.00 | $110,037 |
| WAS pumps (100 gpm), valves and accessories | | | ea | 2 | $8,600.00 | $17,200 |
| Subtotal | | | | | | |
| Pump Installation | | | ls | 0.55 | $127,237.00 | $69,980 |
| Valves and flow meters | | | ls | 1 | $20,000.00 | $20,000 |
| Crane | | | ls | 1 | $18,000.00 | $18,000 |
| Piping and fittings | | | ls | 1 | $40,000.00 | $40,000 |
| Painting | | | ls | 1 | $15,000.00 | $15,000 |
| SUBTOTAL | | | | | | $507,817.35 |
| Undefined Elements | | 10.00% | | | | $50,782 |
| General Conditions | | 4.00% | | | | $20,313 |
| Mobilization & Shakedown | | 3.00% | | | | $15,235 |
| TOTAL | | | | | | $594,100.00 |

PRELIMINARY COST ESTIMATE
Item U: Laboratory Testing Services

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 14, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| Laboratory Services | ea | 1 | $100,000.00 | $100,000 |
| | | | | $0 |
| | | | | $0 |
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| SUBTOTAL | | | | $100,000.00 |
| Undefined Elements | | | | $0 |
| General Conditions | | | | $0 |
| Mobilization & Shakedown | | | | $0 |
| TOTAL | | | | $100,000.00 |

PRELIMINARY COST ESTIMATE
Item V: Laboratory and Administration/Control Building

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 29, 2004

| ITEM | | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|---|
| Building | 60 | 40 | | sf | 2400 | $400.00 | $960,000 |
| | | | | | | | $0 |
| | | | | | | | $0 |
| Control Room Area | | 30 | 30 | sf | 900 | $220.00 | $198,000 |
| | | | | | | | $0 |
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| SUBTOTAL | | | | | | | $1,158,000.00 |
| Undefined Elements | | 10.00% | | | | | $115,800 |
| General Conditions | | 4.00% | | | | | $46,320 |
| Mobilization & Shakedown | | 3.00% | | | | | $34,740 |
| TOTAL | | | | | | | $1,354,900.00 |

PRELIMINARY COST ESTIMATE
Item W: Demolition

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 21, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **Stage 1 and Stage 2** | | | | |
| Concrete slabs | cy | 1059 | | |
| Concrete walls | cy | 2112 | | |
| Fill materials | cy | 12852 | | |
| **Estimated time to demolish the following structures** | | | | |
| Gravity thickener | days | 10 | | |
| Influent screw pump station | days | 40 | | |
| RAS screw pump station | days | 50 | | |
| Head works | days | 40 | | |
| Splitter structure | days | 30 | | |
| Subtotal Stage 2 | | 160 | | |
| **Demolition Crew** | | | | |
| Foreman | day | 1 | $400.00 | |
| Labor 1 | day | 1 | $250.00 | |
| Labor 2 | day | 1 | $250.00 | |
| | day | Subtotal | $900.00 | |
| **Demolition Equipment** | | | | |
| 400 PCL-6 Excavator (SJLouis) | day | 1 | $1,200.00 | |
| Hydraulic Impact Breaker (SJLouis) | day | 1 | $800.00 | |
| Caterpillar 950 Wheel loader (SJLouis) | day | 1 | $460.00 | |
| Demolition Equipment Operator 1 | day | 1 | $400.00 | |
| Demolition Equipment Operator 2 | day | 1 | $400.00 | |
| Demolition Equipment Operator 3 | day | 1 | $400.00 | |
| | day | Subtotal | $3,660.00 | |
| **Hauling Equipment** | | | | |
| 25 ton dump truck | day | 1 | $600.00 | |
| Truck driver | day | 1 | $320.00 | |
| 25 ton crane | day | 1 | $680.00 | |
| 25 ton crane operator | day | 1 | $400.00 | |
| | day | Subtotal | $2,000.00 | |
| **Demolition Costs: Gravity Thickener** | | | | |
| Labor | days | 10 | $900.00 | $9,000 |
| Demolition Equipment | days | 10 | $3,660.00 | $36,600 |
| Hauling Equipment | days | 10 | $2,000.00 | $20,000 |
| **Hauling Costs to Roswell Landfill** | miles | | | |
| cy / cy per trk | | | | |
| Gravity Thickene 125 / 30 / 4 | miles | 542 | $8.00 | $4,333 |
| Number trips 130 / 4 | | | | |
| Miles | | | | |
| **Landfill Charges** | ton | 43 | $10.00 | $428 |
| 0.0135 ton/cy | | | | |

| ITEM | | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|---|
| **Demolition Costs: Stage 2** | | | | | | | |
| Labor | | | | days | 160 | $900.00 | $144,000 |
| Demolition Equipment | | | | days | 160 | $3,660.00 | $585,600 |
| Hauling Equipment | | | | days | 160 | $2,000.00 | $320,000 |
| **Hauling Costs to Roswell Landfill** | | | | miles | | | |
| Stage 2 | cy | cy per trk | | | | | |
| Number trips | 3171 | 30 | 106 | | | | |
| Miles | 130 | 106 | | miles | 13741 | $8.00 | $109,928 |
| **Backfilling Costs** | | | | | | | |
| Stage 1 | | | | cy | 652 | $2.00 | $1,304 |
| Stage 2 | | | | cy | 12852 | $2.00 | $25,704 |
| **Removal and capping of existing piping** | | | | ls | 1 | $60,000.00 | $60,000 |
| **Electrical Demolition** | | | | days | 30 | $1,000.00 | $30,000 |
| SUBTOTAL | | | | | | | $1,346,897.33 |
| Undefined Elements | | | | | | | $0 |
| General Conditions | | 4.00% | | | | | $53,876 |
| Mobilization & Shakedown | | 3.00% | | | | | $40,407 |
| TOTAL | | | | | | | $1,441,200.00 |

PRELIMINARY COST ESTIMATE
Item X: Building In lieu of Canopy

Alternative 2: Single Basin Nitrification/Denitrification
DATE: Dec 29, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| Building Size | 60 | 60 | sf | 3600 | $180.00 | $648,000 |
| | | | | | | $0 |
| | | | | | | $0 |
| less: | | | | | | $0 |
| Canopy Cover Structure | | | sf | -3600 | $30.00 | ($108,000) |
| Site Preparation | | | ls | -1 | $10,000.00 | ($10,000) |
| | | | | | | $0 |
| | | | | | | $0 |
| | | | | | | $0 |
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| | | | | | | $0 |
| SUBTOTAL | | | | | | $530,000.00 |
| Undefined Elements | | 10.00% | | | | $53,000 |
| General Conditions | | 4.00% | | | | $21,200 |
| Mobilization & Shakedown | | 3.00% | | | | $15,900 |
| TOTAL | | | | | | $620,100.00 |

PRELIMINARY COST ESTIMATE
Item Z: Electricity Costs

Alternative 2: Single Basin Nitrification/Denitrification
DATE: 30-Dec-04

| ITEM | UNIT | QUANT | UNIT PRICE ($/kWh) | COST ESTIMATE ($/yr) |
|---|---|---|---|---|
| Influent Pumps | kWh/d | 725.28 | $0.08 | $21,193 |
| Bar Screen | kWh/d | 11.4 | $0.08 | $333 |
| Screenings Conveyor/Compactor | kWh/d | 15.05 | $0.08 | $440 |
| Grit Classifier | kWh/d | 7.6 | $0.08 | $222 |
| Grit Lift Pumps | kWh/d | 30.43 | $0.08 | $889 |
| Aerated Grit Blowers | kWh/d | 204.11 | $0.08 | $5,964 |
| Anaerobic Selector Mixers | kWh/d | 91.2 | $0.08 | $2,665 |
| Anoxic Selector Mixers | kWh/d | 0 | $0.08 | $0 |
| Aeration Basin Blowers | kWh/d | 4637.58 | $0.08 | $135,510 |
| Final Clarifiers | kWh/d | 12 | $0.08 | $351 |
| UV Units | kWh/d | 1440 | $0.08 | $42,077 |
| Aerobic Digester Blowers | kWh/d | 2341.84 | $0.08 | $68,429 |
| Returns Rapid Mixer | kWh/d | 115.2 | $0.08 | $3,366 |
| Returns Flocculator | kWh/d | 15.12 | $0.08 | $442 |
| Returns Clarifiers | kWh/d | 12 | $0.08 | $351 |
| RAS Pumps | kWh/d | 544.28 | $0.08 | $15,904 |
| Scum Pumps | kWh/d | 60.88 | $0.08 | $1,779 |
| WAS Pumps | kWh/d | 14.21 | $0.08 | $415 |
| Thickened Sludge Pump | kWh/d | 2.56 | $0.08 | $75 |
| Digested Sludge Pump | kWh/d | 4.57 | $0.08 | $134 |
| Alum Sludge Pump | kWh/d | 9.89 | $0.08 | $289 |
| Returns Pump | kWh/d | 29.05 | $0.08 | $849 |
| Chemical Feed Pumps | kWh/d | 24 | $0.08 | $701 |
| Belt Thickener | kWh/d | 40 | $0.08 | $1,169 |
| Belt Press | kWh/d | 31 | $0.08 | $906 |

| | | |
|---|---|---|
| Subtotal System Operation | $ | 304,450 |
| Subtotal System Maintenance (Estimate 1% of capital cost) | $ | 252,280 |
| **Total O&M Cost ($/yr)** | **$** | **556,730** |
| TOTAL ($/yr) | $ | 556,730 |
| Present Worth | $ | 8,284,150 |

# APPENDIX F

# ALTERNATIVE 3
# MEMBRANE BIOREACTORS (MBR)

# CONCEPTUAL PROJECT COSTS

# ALTERNATIVE 3 - MEMBRANE BIOREACTORS
# CONCEPTUAL PROJECT COSTS
# WASTEWATER TREATMENT PLANT IMPROVEMENTS

| **Construction Costs** | Amount |
|---|---|
| MBR Structure and Blowers/Canopy Structure/Alkalinity Augmentation | $10,476,000 |
| Influent Pump Station | $1,332,000 |
| Mechanical Dewatering Facilities | $1,776,000 |
| Aerobic Digester and Blower Structure | $1,227,000 |
| Chemical Precipitation Filtrate - Phosphorus Removal | $775,000 |
| Phosphorus Filtrate Pump Station | $234,000 |
| UV Disinfection Building | $656,000 |
| Yard Piping Improvements | $328,000 |
| Site Improvements | $176,000 |
| Headworks | $765,000 |
| RAS/WAS Pump Station | $594,000 |
| Laboratory and Administration/Control Building | $1,355,000 |
| Electrical | $2,560,000 |
| Laboratory Testing Services | $100,000 |
| Subtotal | $22,354,000 |
| | |
| Other Support Facilities: | |
| Demolition | $1,441,000 |
| Subtotal of New Facilities | $23,795,000 |
| | |
| Construction Contingencies @ 10% | $2,380,000 |
| Subtotal | $26,175,000 |
| | |
| NMGRT @ 7.6875% | $2,012,000 |
| Total Construction Costs | $28,187,000 |
| | |
| **Professional Engineering Services Allowance @ 9.0%** | |
| Basic design services and allowance for special services including construction inspection (18 months), soils investigation, surveys, aerial mapping, operation and maintanance manual, and startup services | $2,537,000 |
| | |
| NMGRT @ 6.75% | $171,000 |
| Total Professional Engineering Services | $2,708,000 |
| | |
| **Total Project Costs** | $30,895,000 |

# CONSTRUCTION COST ESTIMATE
## ALTERNATIVE 3 MEMBRANE BIOREACTORS

COST SUMMARY
MOLZEN-CORBIN & ASSOCIATES
JOB NO: RUI 21-71.D03

PREPARED BY: A. Campos
PRINT DATE:
DATE PREPARED: 1/10/2005

| ITEM | DESIGN COST ESTIMATE |
|---|---|
| Item E: MBR Structure and Blowers/Canopy Structure/Alkalinity Augmentation | $10,476,300 |
| Item F: Influent Pump Station | $1,331,700 |
| Item J: Mechanical Dewatering Building | $1,775,900 |
| Item K: Aerobic Digester and Blower Structure | $1,227,300 |
| Item L: Chemical Precipitation Filtration - Phosphorus Removal | $774,900 |
| Item M: Phosphorus Filtrate Pump Station | $234,000 |
| Item N: UV Disinfection and Building | $656,200 |
| Item Q: Yard Piping Improvements | $327,600 |
| Item R: Site Improvements | $175,500 |
| Item S: Headworks | $765,400 |
| Item T: RAS & WAS Pump Station | $594,100 |
| Item V: Laboratory and Administrative/Control Building | $1,354,900 |
| Electrical | $2,560,200 |
| Item U: Laboratory Testing Services | $100,000 |
| Item W: Demolition | $1,441,200 |
| SUBTOTAL | $23,795,200 |
| Construction Contingencies 10.00% | $2,379,520 |
| TOTAL | $26,174,720 |
| STATE TAX (construction) 7.68750% | $2,012,182 |
| TOTAL ESTIMATED CONSTRUCTION COSTS | $28,186,902 |

PRELIMINARY COST ESTIMATE Alternative 3: Membrane Bioreactors
Item E: MBR Structure and Blowers/Canopy Structure/Alkalinity Augmentation DATE: Dec 30, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **MBR/BNR Structure** | | | | |
| Concrete walls | cy | 1100 | $500.00 | $550,000 |
| Concrete floor | cy | 670 | $500.00 | $335,000 |
| Concrete walkway | cy | 40 | $500.00 | $20,000 |
| Inlet box | cy | 30 | $500.00 | $15,000 |
| Alum Covers over MBR Basins | sf | 2020 | $40.00 | $80,800 |
| Excavation | cy | 2400 | $10.00 | $24,000 |
| Backfill | cy | 800 | $12.00 | $9,600 |
| Miscellaneous metal works | ls | 1 | $25,000.00 | $25,000 |
| Painting Interior | sf | 28900 | $4.00 | $115,600 |
| Painting Exterior | sf | 4900 | $4.00 | $19,600 |
| Stairways | ea | 3 | $20,000.00 | $60,000 |
| Hand Rail | lf | 1030 | $18.00 | $18,540 |
| **Piping: Exterior to Blower Structure** | | | | |
| Air Piping Header (24") HDG | lf | 80 | $110.00 | $8,800 |
| Air Piping Header (12") HDG | lf | 420 | $60.00 | $25,200 |
| Air Piping Header (16") HDG | lf | 220 | $70.00 | $15,400 |
| Misc air piping supports, etc | ls | 1 | $8,000.00 | $8,000 |
| Drain Piping and valves | lf | 200 | $60.00 | $12,000 |
| Liquid: 3" to 12" Header DIP | lf | 410 | $60.00 | $24,600 |
| Liquid: 16" Header DIP | lf | 80 | $90.00 | $7,200 |
| Liquid: 24" Header DIP | lf | 160 | $120.00 | $19,200 |
| **MBR Equipment** | | | | |
| MBR Equipment Package w/ blower & pumps | ls | 1 | $4,330,000 | $4,330,000 |
| MBR Equipment: Installation | ls | 0.45 | $4,330,000 | $1,948,500 |
| Estimated adder for extra anoxic mixers (installed) | ls | 1.35 | $50,000 | $67,500 |
| Adder for air bridges (installed) | ls | 1.35 | $40,000 | $54,000 |
| **Blower and Pump Building** | | | | |
| Building 80x40 | sf | 3200 | $180.00 | $576,000 |
| Blower Discharge valves and miscellaneous | ls | 1 | $15,000.00 | $15,000 |
| Hoist system | ls | 1 | $40,000.00 | $40,000 |
| Emergency Generator (installed) outside | ls | 1.3 | $400,000.00 | $520,000 |
| **Alkalinity Augmentation** | | | | |
| Place metering pumps, piping and chemical storage in Headworks Structure | | | | |
| Liquid soda ash feed pumps: equipment | ea | 2 | $2,000.00 | $4,000 |
| Liquid soda ash feed pumps: installation | ls | 0.5 | $4,000.00 | $2,000 |
| Piping | lf | 40 | $10.00 | $400 |
| Misc valves and support | ls | 1 | $200.00 | $200 |
| Soda Ash Containment Area Liner | ls | 1 | $3,000.00 | $3,000 |
| SUBTOTAL | | | | $8,954,140.00 |
| Undefined Elements 10.00% | | | | $895,414 |
| General Conditions 4.00% | | | | $358,166 |
| Mobilization & Shakedown 3.00% | | | | $268,624 |
| TOTAL | | | | $10,476,300.00 |

PRELIMINARY COST ESTIMATE
Item F: Influent Pump Station

Alternative 3: Membrane Bioreactors

DATE: Dec 29, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| **Lift Station Structure** | | | | | |
| Wet well structure | 20L x 12W x 20D | cy | 1208 | $500.00 | $604,000 |
| Excavation | | cy | 1720 | $10.00 | $17,200 |
| Backfill | | cy | 1440 | $12.00 | $17,280 |
| Metal Work (includes hoist structure) | | ls | 1 | $20,000.00 | $20,000 |
| Valve Pit Structure | | ls | 1 | $30,000.00 | $30,000 |
| Dewatering | | ls | 1 | $25,000.00 | $25,000 |
| **Equipment** | | | | | |
| 3 submersible pumps and accessories | | ls | 1.55 | $118,820.00 | $184,171 |
| Installation of well well piping | | ls | 1 | $40,000.00 | $40,000 |
| Wet well fan and accessories | | ls | 1 | $10,000.00 | $10,000 |
| Piping in wetwell and valve pit | | ls | 1 | $26,000.00 | $26,000 |
| Inlet Sewer | | ls | 1 | $12,000.00 | $12,000 |
| Crane and Structural Frame | | ls | 1 | $26,000.00 | $26,000 |
| Forcemain header | | ls | 1 | $24,000.00 | $24,000 |
| Painting Interior | | sf | 1350 | $8.00 | $10,800 |
| Painting Exterior | | sf | 480 | $4.00 | $1,920 |
| Painting Top Deck | | sf | 240 | $4.00 | $960 |
| 18" Flow Meter | | ls | 1.9 | $4,655.00 | $8,845 |
| Building for Electrical Equipment | | sf | 400 | $200.00 | $80,000 |
| SUBTOTAL | | | | | $1,138,175.50 |
| Undefined Elements | 10.00% | | | | $113,818 |
| General Conditions | 4.00% | | | | $45,527 |
| Mobilization & Shakedown | 3.00% | | | | $34,145 |
| TOTAL | | | | | $1,331,700.00 |

PRELIMINARY COST ESTIMATE
Item J: Mechanical Dewatering Building

Alternative 3: Membrane Bioreactors

DATE: Dec 15, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| Dewatering Structure | | | | | | |
| Building | 60 | 85 | sf | 5100 | $150.00 | $765,000 |
| Thickening Belt, SS Frame | | | ls | 1 | $118,000.00 | $118,000 |
| Thickening Belt: installation | | | ls | 0.2 | $23,600.00 | $23,600 |
| Control Panel | | | ls | 1 | $30,000.00 | $30,000 |
| Alum platform and stairs | | | ls | 1 | $25,000.00 | $25,000 |
| Alum platform and stairs: installation | | | ls | 0.35 | $8,750.00 | $8,750 |
| Thickened sludge hopper | | | ls | 1 | $5,000.00 | $5,000 |
| Thickened sludge hopper: installation | | | ls | 0.35 | $1,750.00 | $1,750 |
| Polymer system: equipment | | | ls | 1 | $16,000.00 | $16,000 |
| Polymer system: installation | | | ls | 0.45 | $7,200.00 | $7,200 |
| Dewatering Belt, SS Frame | | | ls | 1 | $262,500.00 | $262,500 |
| Thickening Belt: installation | | | ls | 0.2 | $52,500.00 | $52,500 |
| Control Panel | | | ls | 1 | $40,000.00 | $40,000 |
| Alum platform and stairs | | | ls | 1 | $25,000.00 | $25,000 |
| Alum platform and stairs: installation | | | ls | 0.35 | $8,750.00 | $8,750 |
| Conveyor system | | | ls | 1 | $37,000.00 | $37,000 |
| Conveyor system: installation | | | ls | 0.45 | $16,650.00 | $16,650 |
| Polymer system: equipment | | | ls | 1 | $16,000.00 | $16,000 |
| Polymer system: installation | | | ls | 0.45 | $7,200.00 | $7,200 |
| Thickened Sludge Pumps (Voglesand) | | | ea | 2 | $10,000.00 | $20,000 |
| Thickened Sludge Pumps: installation | | | ls | 0.35 | $20,000.00 | $7,000 |
| Flow meter | | | ls | 1 | $8,000.00 | $8,000 |
| Piping, fittings, valves | | | ls | 1 | $7,000.00 | $7,000 |
| Miscellaneous Metal Works | | | ls | 1 | $4,000.00 | $4,000 |
| Washwater piping system | | | ls | 1 | $6,000.00 | $6,000 |
| SUBTOTAL | | | | | | $1,517,900.00 |
| Undefined Elements | | 10.00% | | | | $151,790 |
| General Conditions | | 4.00% | | | | $60,716 |
| Mobilization & Shakedown | | 3.00% | | | | $45,537 |
| TOTAL | | | | | | $1,775,900.00 |

PRELIMINARY COST ESTIMATE
Item K: Aerobic Digester and Blower Structure

Alternative 3: Membrane Bioreactors
DATE: Dec 21, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **Size: 28x28x22 swd (three basins total)** | | | | |
| Equipment for Basin | | | | |
| Process aeration equipment | ls | 1.45 | $135,000.00 | $195,750 |
| 8" telescoping valves and controls (3 total) | ls | 1.45 | $28,000.00 | $40,600 |
| Platforms and stairs | ls | 1 | $20,000.00 | $20,000 |
| Down opening weir gates | ea | 4 | $4,000.00 | $16,000 |
| Handrail | lf | 120 | $18.00 | $2,160 |
| Basin Structure | | | | |
| Concrete Walls | cy | 385 | $500.00 | $192,500 |
| Concrete Floor | cy | 165 | $500.00 | $82,500 |
| Concrete walkway | cy | 5 | $500.00 | $2,500 |
| Excavation and Backfill | ls | 1 | $4,000.00 | $4,000 |
| Interior coating system | sf | 8070 | $4.00 | $32,280 |
| Exterior coating system | sf | 4720 | $4.00 | $18,880 |
| 10" air piping and valves 3 each | lf | 80 | $50.00 | $4,000 |
| 8" supernatant drain line | lf | 30 | $40.00 | $1,200 |
| 8" supernatant drain shutoff valves | ea | 3 | $400.00 | $1,200 |
| Blower and Digested Pump Structure | | | | |
| Building 40 30 | sf | 1200 | $150.00 | $180,000 |
| PD blowers: equipment 4 total | ls | 1 | $131,500.00 | $131,500 |
| PD blowers: installation | ls | 0.45 | $59,175.00 | $59,175 |
| Blower piping and valves (8" discharge to 16" header | ls | 1 | $15,000.00 | $15,000 |
| Blower shut off valves | ea | 4 | $400.00 | $1,600 |
| Blower check valves | ea | 4 | $300.00 | $1,200 |
| Digested Sludge Pumps (Voglesand) | ea | 2 | $11,000.00 | $22,000 |
| Digested Sludge Pumps: installation | ls | 0.45 | $22,000.00 | $9,900 |
| Flow meter | ls | 1 | $8,000.00 | $8,000 |
| Piping, fittings, valves | ls | 1 | $7,000.00 | $7,000 |
| SUBTOTAL | | | | $1,048,945.00 |
| Undefined Elements 10.00% | | | | $104,895 |
| General Conditions 4.00% | | | | $41,958 |
| Mobilization & Shakedown 3.00% | | | | $31,468 |
| TOTAL | | | | $1,227,300.00 |

PRELIMINARY COST ESTIMATE Alternative 3: Membrane Bioreactors

Item L: Chemical Precipitation Filtration - Phosphorus Removal DATE: Dec 20, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| **Equipment Removal** | | | | |
| Remove clarifier equipment and center column | crew-day | 10 | $2,000.00 | $20,000 |
| Remove clarifier equipment and center column | crew-day | 10 | $2,000.00 | $20,000 |
| | | | | |
| Structure Improvements | ea | 2 | $25,000.00 | $50,000 |
| Interior painting | ea | 3000 | $7.00 | $21,000 |
| Exterior painting | ea | 1400 | $6.00 | $8,400 |
| Miscellaneous piping | ea | 2 | $9,000.00 | $18,000 |
| | | | | |
| **Equipment** | | | | |
| New Clarifier Mechanism: equipment | ea | 2 | $88,000.00 | $176,000 |
| New Clarifier Mechanism: installation | ls | 0.55 | $176,000.00 | $96,800 |
| Alum feed system: equipment | ea | 1 | $20,000.00 | $20,000 |
| Alum feed system: installation | ls | 0.45 | $20,000.00 | $9,000 |
| Rapid mix and bridge: equipment | ea | 1 | $12,500.00 | $12,500 |
| Rapid mix and bridge: installation | ls | 0.45 | $12,500.00 | $5,625 |
| Flocculator: equipment | ea | 1 | $8,000.00 | $8,000 |
| Flocculator: installation | ls | 0.45 | $8,000.00 | $3,600 |
| Alum sludge pumps (voglesan pumps 18 gpm) | ea | 2 | $10,000.00 | $20,000 |
| Alum sludge pumps: installation | ls | 0.45 | $20,000.00 | $9,000 |
| Flow meter | ea | 1 | $8,000.00 | $8,000 |
| Sludge pump piping, valve, fittings | ls | 1 | $4,000.00 | $4,000 |
| | | | | |
| Building 20 20 | sf | 400 | $150.00 | $60,000 |
| Concrete slab with curbs for alum storage | cy | 20 | $400.00 | $8,000 |
| Concrete pit for rapid mx: 9x9x12H (10swd) | cy | 30 | $500.00 | $15,000 |
| Concrete pit for rapid mx: 15x15x16H (14swd) | cy | 55 | $500.00 | $27,500 |
| Handrail | lf | 96 | $18.00 | $1,728 |
| Grating | sf | 60 | $20.00 | $1,200 |
| Stairs | ea | 2 | $6,000.00 | $12,000 |
| Excavation and Backfill | ea | 2 | $5,500.00 | $11,000 |
| | | | | |
| Inlet Splitter Box: 8x4x4H | | | | |
| 24" Down opening weir gates | ea | 2 | $2,000.00 | $4,000 |
| 24" Down opening weir gates: installation | ls | 0.45 | $4,000.00 | $1,800 |
| Handrail | lf | 30 | $18.00 | $540 |
| Grating | sf | 32 | $20.00 | $640 |
| Concrete | cy | 12 | $500.00 | $6,000 |
| Excavation and Backfill | ls | 1 | $3,000.00 | $3,000 |
| SUBTOTAL | | | | $662,333.00 |
| Undefined Elements 10.00% | | | | $66,233 |
| General Conditions 4.00% | | | | $26,493 |
| Mobilization & Shakedown 3.00% | | | | $19,870 |
| **TOTAL** | | | | **$774,900.00** |

PRELIMINARY COST ESTIMATE
Item M: Phosphorus Filtrate Pump Station

Alternative 3: Membrane Bioreactors
DATE: Dec 14, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| Submersible pump lift station for 287 gpm | | ls | 1 | $200,000.00 | $200,000 |
| 2 pumps installed | | | | | $0 |
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| SUBTOTAL | | | | | $200,000.00 |
| Undefined Elements | 10.00% | | | | $20,000 |
| General Conditions | 4.00% | | | | $8,000 |
| Mobilization & Shakedown | 3.00% | | | | $6,000 |
| TOTAL | | | | | $234,000.00 |

PRELIMINARY COST ESTIMATE
Item N: UV Disinfection and Building

Alternative 3: Membrane Bioreactors
DATE: Dec 22, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| Concrete Structure: walls and slab | | | cy | 56 | $500.00 | $28,000 |
| Excavation | | | cy | 800 | $5.00 | $4,000 |
| Backfill | | | cy | 600 | $8.00 | $4,800 |
| Dewatering | | | ls | 1 | $6,000.00 | $6,000 |
| Building | 26 | 40 | sf | 1040 | $120.00 | $124,800 |
| | | | | | | $0 |
| UV: Equipment (2 units) | | | ea | 2 | $117,850.00 | $235,700 |
| UV: Installation | | | ls | 0.2 | $23,570.00 | $23,570 |
| Process Piping | | | | | | |
| 16" pipe for UV Units | | | ls | 1 | $24,000.00 | $24,000 |
| 20" Valves | | | ea | 4 | $14,000.00 | $56,000 |
| Flow Meter | | | ls | 1 | $12,000.00 | $12,000 |
| Washwater Pumps Installed | | | ea | 2 | $10,000.00 | $20,000 |
| Clarifier Spray Pumps Installed | | | ea | 2 | $10,000.00 | $20,000 |
| WW Piping | | | ls | 1 | $2,000.00 | $2,000 |
| SUBTOTAL | | | | | | $560,870.00 |
| Undefined Elements | 10.00% | | | | | $56,087 |
| General Conditions | 4.00% | | | | | $22,435 |
| Mobilization & Shakedown | 3.00% | | | | | $16,826 |
| TOTAL | | | | | | $656,200.00 |

PRELIMINARY COST ESTIMATE
Item R: Site Improvements

Alternative 3: Membrane Bioreactors
DATE: Dec 14, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| New Site Improvements | | ls | 1 | $150,000.00 | $150,000 |
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| SUBTOTAL | | | | | $150,000.00 |
| Undefined Elements | 10.00% | | | | $15,000 |
| General Conditions | 4.00% | | | | $6,000 |
| Mobilization & Shakedown | 3.00% | | | | $4,500 |
| TOTAL | | | | | $175,500.00 |

PRELIMINARY COST ESTIMATE
Item S: Headworks

Alternative 3: Membrane Bioreactors

DATE: Dec 22, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| **Bar Screen Structure** | | | | | | |
| Concrete | | | cy | 90 | $500.00 | $45,000 |
| Excavation and backfill | | | ls | 1 | $9,000.00 | $9,000 |
| Painting | | | ls | 1 | $10,000.00 | $10,000 |
| Sidewalks and slab for degritter | | | ls | 1 | $14,000.00 | $14,000 |
| Grating | | | sf | 300 | $40.00 | $12,000 |
| Miscellaneous metalwork | | | ls | 1 | $6,000.00 | $6,000 |
| Stairs | | | ea | 2 | $16,000.00 | $32,000 |
| Handrail | | | lf | 200 | $18.00 | $3,600 |
| | | | | | | |
| **Aerated Grit Chamber Structure** | | | | | | |
| Concrete | | | cy | 180 | $500.00 | $90,000 |
| Excavation and backfill | | | ls | 1 | $9,000.00 | $9,000 |
| Painting | | | ls | 1 | $12,000.00 | $12,000 |
| Sidewalks | | | ls | 1 | $5,000.00 | $5,000 |
| Doors and windows | | | ls | 1 | $3,000.00 | $3,000 |
| | | | | | | |
| **Equipment** | | | | | | |
| Process piping and valves | | | ls | 1 | $18,000.00 | $18,000 |
| Mechanical bar screen (1/8" openings) | | | ls | 1.45 | $105,000.00 | $152,250 |
| Screenings, conveyor/compactor | | | ls | 1.45 | $25,000.00 | $36,250 |
| Aeration grit chamber equipment | | | ls | 1.45 | $30,000.00 | $43,500 |
| Aeration grit blowers | | | ls | 1.45 | $11,300.00 | $16,385 |
| Add cyclone to existing grit classifier | | | ls | 1.45 | $15,000.00 | $21,750 |
| Relocate existing grit classifier | | | ls | 1 | $2,000.00 | $2,000 |
| Grit air lift pumps | | | ls | 1.45 | $30,000.00 | $43,500 |
| Manual bar screen | | | ls | 1.45 | $5,000.00 | $7,250 |
| 30" W slide gates | 5000 | 6 | ls | 1.45 | $30,000.00 | $43,500 |
| 30" sluice gate flange end | | | ls | 1.45 | $9,000.00 | $13,050 |
| Stainless steel chute | | | ls | 1.45 | $1,500.00 | $2,175 |
| | | | | | | |
| 30" DIP | | | lf | 40 | $100.00 | $4,000 |
| SUBTOTAL | | | | | | $654,210.00 |
| Undefined Elements | 10.00% | | | | | $65,421 |
| General Conditions | 4.00% | | | | | $26,168 |
| Mobilization & Shakedown | 3.00% | | | | | $19,626 |
| TOTAL | | | | | | $765,400.00 |

PRELIMINARY COST ESTIMATE
Item T: RAS & WAS Pump Station

Alternative 3: Membrane Bioreactors

DATE: Dec 16, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| **Concrete (slab, footings, pipe trenches)** | | | | | | |
| Wall and slabs | | | cy | 64 | $400.00 | $25,600 |
| Building | 40 | 40 | sf | 1600 | $120.00 | $192,000 |
| **Equipment** | | | | | | |
| RAS pumps (1,300 gpm), valves and accessories | | | ea | 3 | $36,679.00 | $110,037 |
| WAS pumps (100 gpm), valves and accessories | | | ea | 2 | $8,600.00 | $17,200 |
| Subtotal | | | | | | |
| Pump Installation | | | ls | 0.55 | $127,237.00 | $69,980 |
| Valves and flow meters | | | ls | 1 | $20,000.00 | $20,000 |
| Crane | | | ls | 1 | $18,000.00 | $18,000 |
| Piping and fittings | | | ls | 1 | $40,000.00 | $40,000 |
| Painting | | | ls | 1 | $15,000.00 | $15,000 |
| SUBTOTAL | | | | | | $507,817.35 |
| Undefined Elements | 10.00% | | | | | $50,782 |
| General Conditions | 4.00% | | | | | $20,313 |
| Mobilization & Shakedown | 3.00% | | | | | $15,235 |
| TOTAL | | | | | | $594,100.00 |

PRELIMINARY COST ESTIMATE
Item Q: Yard Piping Improvements

Alternative 3: Membrane Bioreactors
DATE: Dec 15, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| New Yard Piping and Valves | | ls | 1 | $280,000.00 | $280,000 |
| | | | | | $0 |
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| SUBTOTAL | | | | | $280,000.00 |
| Undefined Elements | 10.00% | | | | $28,000 |
| General Conditions | 4.00% | | | | $11,200 |
| Mobilization & Shakedown | 3.00% | | | | $8,400 |
| TOTAL | | | | | $327,600.00 |

PRELIMINARY COST ESTIMATE
Item R: Site Improvements

Alternative 3: Membrane Bioreactors

DATE: Dec 14, 2004

| ITEM | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|
| New Site Improvements | | ls | 1 | $150,000.00 | $150,000 |
| | | | | | $0 |
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| SUBTOTAL | | | | | $150,000.00 |
| Undefined Elements | 10.00% | | | | $15,000 |
| General Conditions | 4.00% | | | | $6,000 |
| Mobilization & Shakedown | 3.00% | | | | $4,500 |
| TOTAL | | | | | $175,500.00 |

PRELIMINARY COST ESTIMATE
Item S: Headworks

Alternative 3: Membrane Bioreactors
DATE: Dec 22, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| **Bar Screen Structure** | | | | | | |
| Concrete | | | cy | 90 | $500.00 | $45,000 |
| Excavation and backfill | | | ls | 1 | $9,000.00 | $9,000 |
| Painting | | | ls | 1 | $10,000.00 | $10,000 |
| Sidewalks and slab for degritter | | | ls | 1 | $14,000.00 | $14,000 |
| Grating | | | sf | 300 | $40.00 | $12,000 |
| Miscellaneous metalwork | | | ls | 1 | $6,000.00 | $6,000 |
| Stairs | | | ea | 2 | $16,000.00 | $32,000 |
| Handrail | | | lf | 200 | $18.00 | $3,600 |
| **Aerated Grit Chamber Structure** | | | | | | |
| Concrete | | | cy | 180 | $500.00 | $90,000 |
| Excavation and backfill | | | ls | 1 | $9,000.00 | $9,000 |
| Painting | | | ls | 1 | $12,000.00 | $12,000 |
| Sidewalks | | | ls | 1 | $5,000.00 | $5,000 |
| Doors and windows | | | ls | 1 | $3,000.00 | $3,000 |
| **Equipment** | | | | | | |
| Process piping and valves | | | ls | 1 | $18,000.00 | $18,000 |
| Mechanical bar screen (1/8" openings) | | | ls | 1.45 | $105,000.00 | $152,250 |
| Screenings, conveyor/compactor | | | ls | 1.45 | $25,000.00 | $36,250 |
| Aeration grit chamber equipment | | | ls | 1.45 | $30,000.00 | $43,500 |
| Aeration grit blowers | | | ls | 1.45 | $11,300.00 | $16,385 |
| Add cyclone to existing grit classifier | | | ls | 1.45 | $15,000.00 | $21,750 |
| Relocate existing grit classifier | | | ls | 1 | $2,000.00 | $2,000 |
| Grit air lift pumps | | | ls | 1.45 | $30,000.00 | $43,500 |
| Manual bar screen | | | ls | 1.45 | $5,000.00 | $7,250 |
| 30" W slide gates | 5000 | 6 | ls | 1.45 | $30,000.00 | $43,500 |
| 30" sluice gate flange end | | | ls | 1.45 | $9,000.00 | $13,050 |
| Stainless steel chute | | | ls | 1.45 | $1,500.00 | $2,175 |
| 30" DIP | | | lf | 40 | $100.00 | $4,000 |
| SUBTOTAL | | | | | | $654,210.00 |
| Undefined Elements | 10.00% | | | | | $65,421 |
| General Conditions | 4.00% | | | | | $26,168 |
| Mobilization & Shakedown | 3.00% | | | | | $19,626 |
| TOTAL | | | | | | $765,400.00 |

PRELIMINARY COST ESTIMATE
Item T: RAS & WAS Pump Station

Alternative 3: Membrane Bioreactors

DATE: Dec 16, 2004

| ITEM | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|
| **Concrete (slab, footings, pipe trenches)** | | | | | | |
| Wall and slabs | | | cy | 64 | $400.00 | $25,600 |
| Building | 40 | 40 | sf | 1600 | $120.00 | $192,000 |
| **Equipment** | | | | | | |
| RAS pumps (1,300 gpm), valves and accessories | | | ea | 3 | $36,679.00 | $110,037 |
| WAS pumps (100 gpm), valves and accessories | | | ea | 2 | $8,600.00 | $17,200 |
| Subtotal | | | | | | |
| Pump Installation | | | ls | 0.55 | $127,237.00 | $69,980 |
| Valves and flow meters | | | ls | 1 | $20,000.00 | $20,000 |
| Crane | | | ls | 1 | $18,000.00 | $18,000 |
| Piping and fittings | | | ls | 1 | $40,000.00 | $40,000 |
| Painting | | | ls | 1 | $15,000.00 | $15,000 |
| SUBTOTAL | | | | | | $507,817.35 |
| Undefined Elements | 10.00% | | | | | $50,782 |
| General Conditions | 4.00% | | | | | $20,313 |
| Mobilization & Shakedown | 3.00% | | | | | $15,235 |
| TOTAL | | | | | | $594,100.00 |

PRELIMINARY COST ESTIMATE
Item U: Laboratory Testing Services

Alternative 3: Membrane Bioreactors
DATE: Dec 14, 2004

| ITEM | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|
| Laboratory Services | ea | 1 | $100,000.00 | $100,000 |
| | | | | $0 |
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| | | | | $0 |
| SUBTOTAL | | | | $100,000.00 |
| Undefined Elements | | | | $0 |
| General Conditions | | | | $0 |
| Mobilization & Shakedown | | | | $0 |
| TOTAL | | | | $100,000.00 |

PRELIMINARY COST ESTIMATE
Item V: Laboratory and Administrative/Control Building

Alternative 3: Membrane Bioreactors
DATE: Dec 29, 2004

| ITEM | | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|---|
| | | | | | | | $0 |
| Building | 60 | 40 | | sf | 2400 | $400.00 | $960,000 |
| | | | | | | | $0 |
| Control Room Area | | 30 | 30 | sf | 900 | $220.00 | $198,000 |
| | | | | | | | $0 |
| | | | | | | | $0 |
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| | | | | | | | $0 |
| | | | | | | | $0 |
| SUBTOTAL | | | | | | | $1,158,000.00 |
| Undefined Elements | | 10.00% | | | | | $115,800 |
| General Conditions | | 4.00% | | | | | $46,320 |
| Mobilization & Shakedown | | 3.00% | | | | | $34,740 |
| TOTAL | | | | | | | $1,354,900.00 |

PRELIMINARY COST ESTIMATE
Item W: Demolition

Alternative 3: Membrane Bioreactors
DATE: Dec 22, 2004

| ITEM | | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|---|
| **Stage 1 and Stage 2** | | | | | | | |
| Concrete slabs | | | | cy | 1059 | | |
| Concrete walls | | | | cy | 2112 | | |
| Fill materials | | | | cy | 12852 | | |
| **Estimated time to demolish the following structures** | | | | | | | |
| Gravity thickener | | | | days | 10 | | |
| Influent screw pump station | | | | days | 40 | | |
| RAS screw pump station | | | | days | 50 | | |
| Head works | | | | days | 40 | | |
| Splitter structure | | | | days | 30 | | |
| Subtotal Stage 2 | | | | | 160 | | |
| **Demolition Crew** | | | | | | | |
| Foreman | | | | day | 1 | $400.00 | |
| Labor 1 | | | | day | 1 | $250.00 | |
| Labor 2 | | | | day | 1 | $250.00 | |
| | | | | day | Subtotal | $900.00 | |
| **Demolition Equipment** | | | | | | | |
| 400 PCL-6 Excavator (SJLouis) | | | | day | 1 | $1,200.00 | |
| Hydraulic Impact Breaker (SJLouis) | | | | day | 1 | $800.00 | |
| Caterpillar 950 Wheel loader (SJLouis) | | | | day | 1 | $460.00 | |
| Demolition Equipment Operator 1 | | | | day | 1 | $400.00 | |
| Demolition Equipment Operator 2 | | | | day | 1 | $400.00 | |
| Demolition Equipment Operator 3 | | | | day | 1 | $400.00 | |
| | | | | day | Subtotal | $3,660.00 | |
| **Hauling Equipment** | | | | | | | |
| 25 ton dump truck | | | | day | 1 | $600.00 | |
| Truck driver | | | | day | 1 | $320.00 | |
| 25 ton crane | | | | day | 1 | $680.00 | |
| 25 ton crane operator | | | | day | 1 | $400.00 | |
| | | | | day | Subtotal | $2,000.00 | |
| **Demolition Costs: Gravity Thickener** | | | | | | | |
| Labor | | | | days | 10 | $900.00 | $9,000 |
| Demolition Equipment | | | | days | 10 | $3,660.00 | $36,600 |
| Hauling Equipment | | | | days | 10 | $2,000.00 | $20,000 |
| **Hauling Costs to Roswell Landfill** | | | | miles | 90 | | |
| Gravity Thickener | cy | cy per trk | | | | | |
| Number trips | 125 | 30 | 4 | | | | |
| Miles | 130 | 4 | | miles | 542 | $8.00 | $4,333 |
| Landfill Charges | | | | | | | |
| 0.0135 ton/cy | | | | ton | 43 | $10.00 | $428 |

| ITEM | | | | UNIT | QUANT | UNIT PRICE | COST ESTIMATE |
|---|---|---|---|---|---|---|---|
| **Demolition Costs: Stage 2** | | | | | | | |
| Labor | | | | days | 160 | $900.00 | $144,000 |
| Demolition Equipment | | | | days | 160 | $3,660.00 | $585,600 |
| Hauling Equipment | | | | days | 160 | $2,000.00 | $320,000 |
| **Hauling Costs to Roswell Landfill** | | | | miles | 90 | | |
| Stage 2 | cy | cy per trk | | | | | |
| Number trips | 3171 | 30 | 106 | | | | |
| Miles | 130 | 106 | | miles | 13741 | $8.00 | $109,928 |
| **Backfilling Costs** | | | | | | | |
| Stage 1 | | | | cy | 652 | $2.00 | $1,304 |
| Stage 2 | | | | cy | 12852 | $2.00 | $25,704 |
| **Removal and capping of existing piping** | | | | ls | 1 | $60,000.00 | $60,000 |
| **Electrical Demolition** | | | | days | 30 | $1,000.00 | $30,000 |
| SUBTOTAL | | | | | | | $1,346,897.33 |
| Undefined Elements | | | | | | | $0 |
| General Conditions | | 4.00% | | | | | $53,876 |
| Mobilization & Shakedown | | 3.00% | | | | | $40,407 |
| TOTAL | | | | | | | $1,441,200.00 |

PRELIMINARY COST ESTIMATE
PAGE Z - Electricity Costs

Alternative 3: Membrane Bioreactor

DATE: 30-Dec-04

| ITEM | UNIT | QUANT | UNIT PRICE ($/kWh) | COST ESTIMATE ($/yr) |
|---|---|---|---|---|
| Influent Pumps | kWh/d | 725.28 | $0.08 | $21,193 |
| Bar Screen | kWh/d | 11.4 | $0.08 | $333 |
| Screenings Conveyor/Compactor | kWh/d | 15.05 | $0.08 | $440 |
| Grit Classifier | kWh/d | 7.6 | $0.08 | $222 |
| Grit Lift Pumps | kWh/d | 30.43 | $0.08 | $889 |
| Aerated Grit Blowers | kWh/d | 204.11 | $0.08 | $5,964 |
| MBR System | kWh/d | 9834 | $0.08 | $287,349 |
| UV Units | kWh/d | 1440 | $0.08 | $42,077 |
| Aerobic Digester Blowers | kWh/d | 2341.84 | $0.08 | $68,429 |
| Returns Rapid Mixer | kWh/d | 115.2 | $0.08 | $3,366 |
| Returns Flocculator | kWh/d | 15.12 | $0.08 | $442 |
| Returns Clarifiers | kWh/d | 12 | $0.08 | $351 |
| RAS Pumps | kWh/d | 544.28 | $0.08 | $15,904 |
| Scum Pumps | kWh/d | 60.88 | $0.08 | $1,779 |
| WAS Pumps | kWh/d | 14.21 | $0.08 | $415 |
| Thickened Sludge Pump | kWh/d | 2.56 | $0.08 | $75 |
| Digested Sludge Pump | kWh/d | 4.57 | $0.08 | $134 |
| Alum Sludge Pump | kWh/d | 9.89 | $0.08 | $289 |
| Returns Pump | kWh/d | 29.05 | $0.08 | $849 |
| Chemical Feed Pumps | kWh/d | 24 | $0.08 | $701 |
| Belt Thickener | kWh/d | 40 | $0.08 | $1,169 |
| Belt Press | kWh/d | 31 | $0.08 | $906 |

| | | |
|---|---|---|
| Subtotal System Operation | $ | 453,274 |
| Subtotal System Maintenance (Estimate 1% of capital cost) | $ | 308,950 |
| **Total O&M Cost ($/yr)** | **$** | **762,224** |
| TOTAL ($/yr) | $ | 762,224 |
| Present Worth | $ | 11,341,899 |